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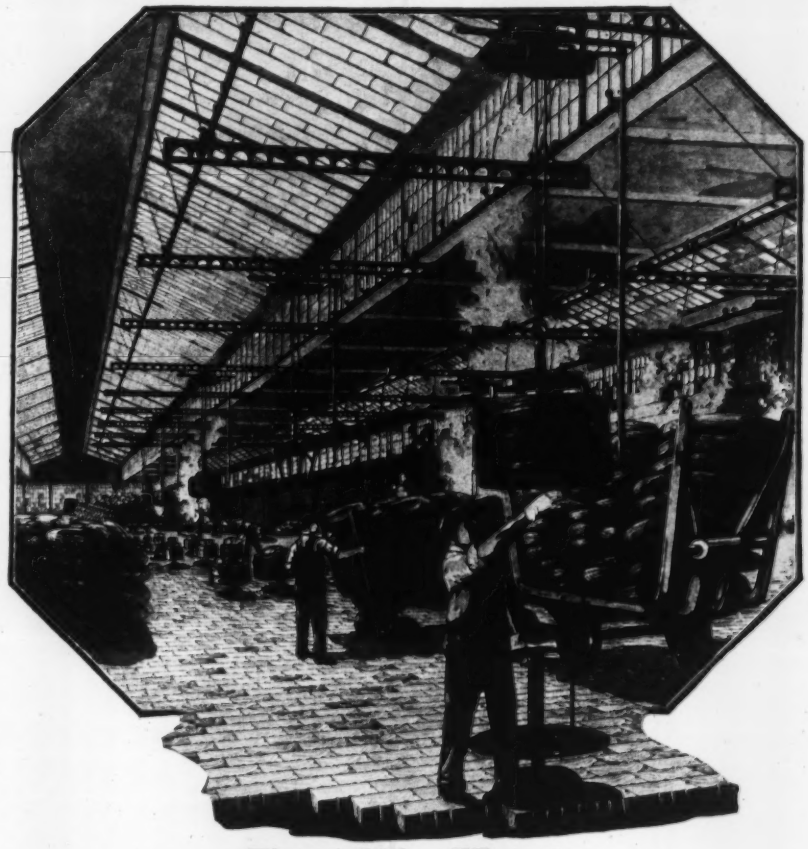

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 104 NEW YORK, FEBRUARY 20, 1930 Number 8

Untimely Wrangling

IT SEEMS preposterous that after years of united struggle fostering the Boulder dam project the interests of southern California at this late date should still be wrangling over a division of the benefits. Recently, in the conference of California, Nevada and Arizona to reach final agreement on water rights, it developed that the Imperial Valley irrigation district's demands and those of the Metropolitan Water District are not in accord—this notwithstanding the fact that these two interests above all others are in a position to gain most from the project. To have such discord continue would be fatal. A united front is necessary to bring the Boulder dam project to success.

Structural Aluminum Tests

DATA yielded by the interesting tests of aluminum alloy beams reported this week place the structural engineer in position to evaluate the new material for its construction possibilities. The data may be supplemented by the statement that a 10-ton bridge crane of aluminum alloy has already been built and put into service, and that working comparisons with a steel crane will soon be available. The new material is costly, but it reduces the weight of the structure; it can be applied as readily as steel to give a desired degree of strength. It works and rivets easily. These are the present facts. What a saving in weight means when translated into cost is of course subject to great variation. But there are on the one hand cases in which every pound means half a dozen additional pounds to carry it—as in the central parts of large cantilever bridges—and on the other hand cases where an unnecessary pound means daily power cost for moving it, as in vehicles or cranes. The primary possibilities for structural aluminum evidently lie in these services. It is the structural engineer's task to explore them and work out the practical field of the material.

Why Falling Derricks?

WHY do building erection derricks continue to topple into crowded streets with startling regularity? Boston reports the latest of these accidents, with the almost inevitable injuring of several passersby. Of all construction accidents the collapse of a building derrick is one of the most dangerous, and one that almost always can be attributed to pure carelessness. There is no excuse for a derrick failure. All derricks have rated capacities, beyond which it is folly to load them. Stresses on guy and load lines can be easily calculated and the proper size cables provided. Connections if properly made will resist the breaking strain of the cables. Why, then, should a derrick fail if properly set up? And why should a derrick be improperly set up? As long as the foolish practice of hoisting over crowded streets is allowed to continue, the least the contractor can do is to provide derricks amply capable of lifting the required loads, see that they are properly set up, and see that the loads are properly handled, in order that the public may receive some share of the protection to which it is rightly entitled.

Mississippi Plan Revision

HEARINGS by the House Committee last week on the Mississippi River flood-control work made a formal beginning on revision of the official plan. Up to now this revision, however urgent, was only a future possibility; the attitude of the army engineers as well as the rigid provisions of the flood-control act were insuperable obstacles to change. The Jadwin faction among the engineers held out for execution of the plan without new study or thinking, even though the working details raised new questions of the gravest kind, and even though these details involved undeniable changes from the adopted plan. New leadership, a momentous court decision on land-damage payments, and the desire of Congress to consider the many protests against the work, have changed the situation. The conscientious view which General Brown, the present Chief of Engineers, takes of his responsibility is reflected in the review which he wrote for *Engineering News-Record* (published Feb. 6). While that article was on the press, on Feb. 4, the federal court at Monroe, La., issued a permanent injunction against construction of the Boeuf floodway until the lands have been acquired, thereby furnishing substantial confirmation of the need for revision. Now there is talk of abandoning the Boeuf, of replanning the Atchafalaya floodway, of building detention reservoirs on tributaries, of replacing the Jadwin "fuseplug" levees by controlled spillways. Restudy and comprehensive thinking are in the air, and later in the year Congress will doubtless revise the act of 1928. The present hearings are but the opening gun of a campaign that will extend over many months. It will not delay work, for the main river will easily absorb all construction energy for some years. But its conclusion, according to present promise, will see a sounder project adopted.

More Work Out of Concrete

GROWING confidence among engineers that concrete designed for a given strength will produce dependable results will lead designers gradually to decrease the gap between strength and working stress, with obvious advantage in economy. Steps in this direction may be seen in the Seattle viaduct slab construction described in this issue. A working stress of 1,200 lb., or four-tenths the concrete strength, cannot fail to produce marked economy in both space and

dollars. Doubtless such progress toward higher working stresses in concrete may be credited to the extensive research work that has been done in this field. It is tangible demonstration of the practical returns which research can yield.

The Author-Chairman Plan

THE first full year of the American Concrete Institute's author-chairman plan of committee work passed into history with the 26th annual convention of the Institute held in New Orleans last week. Briefly, the plan provides that the subject assigned to the committee be reported upon by the chairman, who then submits it to the critic members of his committee, whose comments he may use at his discretion in the final report. A backsight reveals that reports on several timely subjects have been more hurriedly whipped into shape than might have been possible with the usual committee set-up. The ready-mixed concrete specification is one example. An analysis of existing research on the problem of variability of portland cements is another. One advantage, then, of the plan is speed. Another, apparently, is an increase in the number of problems reported upon. Because of the existence of an increased number of committees, it can also be argued that more members of the Institute are serving on committees than ever before. Such a contention, however, is open to some question. While the critics nominally are members of a committee, their influence in formulating plans and initiating ideas is of doubtful value, since the author-chairman prepares the report from his own data. As critics they are in little better position than any other member of the Institute who can discuss and dissent from a committee report. The advantage of teamwork is also lacking in this committee plan. However, the author-chairman plan in effect does not differ from the plan of much other committee work, where the chairman is the main or only producer. On the year's performance it can be said that the new plan of committee work has made available numerous reports readily and rapidly. At present little more can be said for it. It is an experiment which everyone interested in society procedure will watch and study.

Modern Miracles

EVERY part of the country bears witness to the ability of the engineer to work miracles in providing communities with water, even though the sources of supply are most unpromising. It is illustrated anew in the water-treatment plant at Fort Lauderdale, Fla., where a half-dozen processes are applied to a most troublesome type of water from wells. The objects were to get rid of color, taste, hardness and deposits in services and meters, as well as to control the bacterial content of the water. The processes brought into working harmony for these purposes are aeration, chemical treatment, mechanical agitation for mixing, sedimentation, carbonation, filtration and chlorination. Nor is this the whole story. A small city has within a short period located and sunk new wells, rectified water with a combination of faults, forced it a considerable distance through a main that had to be laid under water part of the way, and put down 40 miles of distributing mains. Water, the most vital of public needs, is only one of the many services which the city of today must provide. To engineer, manufacturer and contractor belongs the credit for satisfying these growing wants.

Emulsified Asphalt

BRITISH roadbuilders have the knack of handling emulsified asphalt in penetration macadam construction with greater sureness than their American colleagues. Their results, it appears from the article by Colonel Bowlby in this issue, are due partly to more care, perhaps partly also to superior technique in application. Asphalt emulsions as roadbuilding materials have been handicapped by lack of control in preparing the material and poor technique in its use and application. Not until recently has emulsified asphalt given dependable service in general practice. Excellent roads have been produced, and also unsatisfactory roads—practice has been erratic and uncertain. It is from these older records of use that American roadbuilders have formed their opinion of asphalt emulsions as a penetration material in comparison with the hot oils. Very recently the facts have changed. Cold emulsions have been placed under definite control, and the technique of application is becoming highly developed. English experience encourages consideration anew of an old roadbuilding material.

New Ideas in Bridge Construction

SEVERAL noteworthy features distinguish New Jersey's new concrete highway bridge across the Raritan River at New Brunswick, described in this issue. It is a link in the state's superhighway between New York and Philadelphia, which is to bypass all large towns and eliminate all railroad and many highway grade crossings. By providing a high-level crossing over a navigable stream, the bridge eliminates interruption by river traffic. Celluloid models were used to check the analytical design and to determine the proper location and number of expansion joints in the structure. So much for planning and design. In the construction operations a noteworthy innovation was the use of two 160-ft. traveling towers carrying chutes to place the superstruture concrete, a method chosen after comparison with other methods of placement, including belt conveyors and cableways. Ground conditions at the site were ideal for this type of operation, providing suitable space for plant on the river flats alongside the structure. The erection of the steel trusses for arch centering also was new. Thus the construction brought into service as much original thinking and ingenuity as did the design. From both points of view the New Brunswick bridge is a notable example of concrete bridge engineering.

A Leader Retires

FEW, indeed, are those who can show such a notable record of achievement as does Dean Charles H. Snow, of New York University, who has headed the college of engineering of that institution since 1895. With the close of the current college year he ends a career of thirty-eight years' continuous service to his university, thirty-five of which he has served as dean. It was due to Professor Snow's efforts that the university, in 1896, removed its course in civil engineering from the college of arts and sciences to form the beginnings of the

present college of engineering, which now grants five different degrees in various branches of engineering. So engrossing has been the task of development that Dean Snow has continuously devoted his efforts to the college, refusing even to take the customary sabbatical leaves to which he was entitled. Now, with a remarkable service record, he is retiring to the leisure which he so richly deserves. The good wishes of the profession go with him in his retirement.

Charles T. Hutchinson

THAT rare gift, a soul of warmth and humor, is most truly valued when it is taken away. With the death of Charles T. Hutchinson, fellow-editor and publisher, we have lost such a soul. Even though his sphere of work, by the Golden Gate, was far away, the sense of loss is keen. Engineering industry and journalism need men endowed with the power of shrewd and friendly appreciation. This was Hutchinson's endowment, and for it he will be remembered. Perhaps through the memory some trace of it may still remain and may live in the pages of *Engineering News-Record*.

Engineers and Architects Again

IMPORTANT developments occurred last week in the architect-engineer controversy discussed in this place last week—the attempt of architects in New York State to prevent engineers from acting as principals for owners in a large part of the building field. The regents of the University of the State of New York gave the conflict close study and declined to interpret the architects law in such manner as to restrict the practice of engineering by licensed professional engineers.

As was stated in the previous discussion, engineers have been refused permission to file plans in a number of city building departments on the basis of a letter written by a deputy of the state attorney-general, in which he implied that, pending further interpretation of the architects law by the regents, only architects should be allowed to file building plans. The clause in question states, "This article shall not be construed to affect or prevent the practice of engineering by a licensed professional engineer." The architects wanted this clause construed as meaning the practice of professional engineering *in the building of industrial buildings only*, and they had succeeded to the point of getting the board of engineering examiners to agree to ask the regents to place such an interpretation upon the law.

On Saturday the matter came before the regents for consideration, and after a hearing in which the deputy assistant attorney-general unsuccessfully attempted to justify his opinion, the regents declined to read anything into the law which was not clearly written there. In addition, in order to offset the ill effect caused by the opinion, the regents went on record as finding nothing in the law to indicate that action favorable to the architects is in order. In the words of Regent James Byrne, an able lawyer, "A grave injustice has been done the engineers by this implication that we are to place an interpretation upon this law which we, in my opinion, have no right to do."

A victory for engineers has been won on this point, but it should not be taken as a signal to lay down arms. The apparently innocent ruling of the deputy assistant attorney-general which caused all the trouble was not the result of snap judgment on his part. The architects had pleaded their case with him beforehand and had convinced him of their claim that only architects should act as principals in all but industrial building work. Others have been similarly convinced by plausible but very one-sided arguments. To check the systematic campaign of architects to convert their registration law into a device for the protection of architects rather than a measure of public protection, engineers must continue their educational work until they win definitely recognized position.

Structural Awakening Abroad

AMERICAN engineers who decry our present structural methods as fossilized and out of date could gain some measure of relief by reading a paper entitled "Some American Comparisons," given before the Institution of Structural Engineers (London) by G. S. Bowers, a member who had spent some years in this country. Also, they would find signs of a structural awakening on the part of English engineers.

In pointing out how much more deeply tradition is rooted in England than in the United States and Canada, the author of the recent paper holds up many of our practices as well worth emulating. For instance, in England a conservative attitude is still maintained toward steel working stresses as contrasted with a tendency toward liberalism in using higher unit stresses in America. The English engineer also is handicapped in having fewer structural sections from which to choose, there being only one-half or one-third as many sizes available as are rolled by American mills. The English engineer feels the lack of the wide-flanged sections that have proved so useful in this country. Building height regulations in London and other parts of England make it necessary to restrict ceiling heights in order to provide as many floors as possible in a given building; this means using shallow beams, and the lack of wide-flanged sections makes it necessary to turn to built-up girders.

The English engineer, too, needs a less conservative column formula, which will omit the conditions of end fixing that are now imposed. Live loads in pounds per square foot in London are 100 lb. for offices and 70 lb. for residences. Comparable figures in New York are 60 and 40, and in Toronto 75 and 50. A lighter external wall construction, involving the substitution of hollow tile for brick, as backing, would also effect savings in English structures. A revision upward of the present permissible stress on concrete foundations from the 185 lb. per sq.in. to the American value of 600 lb. per sq.in. would permit the English engineer to use slab bases instead of built-up grillages, with obvious economy. The English fabricating companies, too, were described as far behind American shops in structural practices.

Such comparisons place American structural practices in a very favorable light and give some cause for satisfaction. The real importance of the comparisons, however, lies in the indications that they afford of an awakening abroad to the value of revamping antiquated specifications in the light of modern knowledge. It is to be hoped that during the revamping process many new structural studies will be carried out by the English engineers. Structural engineering can advance more rapidly when attacking on a front of world-wide scope.

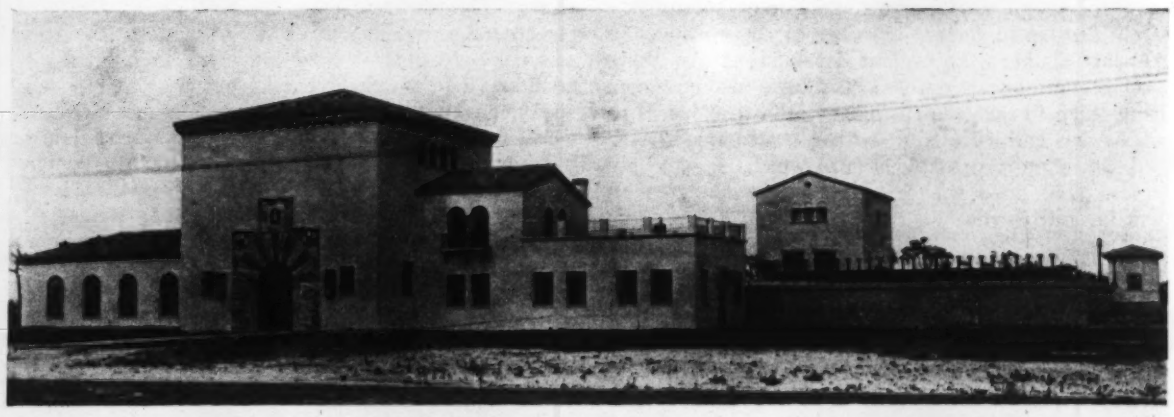

FIG. 1—FRONT VIEW OF TREATMENT PLANT
Showing pump room, entrance foyer with wash-water tank above, carbon dioxide generating room and superintendent's office, sedimentation basins and aerators, chemical house and raw water control house.

New Water-Supply System for Fort Lauderdale

Florida City Gives Elaborate Treatment to Water—Well Water Aerated, Softened, Carbonated, Filtered and Chlorinated in Plant of Architectural Pretension—Forty Miles of New Mains Installed

By F. J. Keis
Solomon, Norcross & Keis, Atlanta, Ga.

THE city of Fort Lauderdale, a popular tourist center on the east coast of Florida, has recently put into operation a complete new plant for treating and distributing its water supply. The old supply failed about four years ago and the new installation supplants it entirely. Although wells are again used as a source of supply, the character of the water obtained from them is such that elaborate treatment is necessary, including aeration, softening, carbonation and filtration. An unusual degree of attention has been paid to the creation of a pleasing appearance in the new plant, as can be seen from the accompanying illustrations.

There are on the east coast of south Florida no rivers or streams suitable for water-supply purposes. The topography is so level that water does not flow with sufficient velocity to erode a stream. There are a few outlets from the Everglades to the sea, supposedly the result of geological disturbances, but these carry highly discolored water and are at times affected by the tidal salt water of the ocean.

Fortunately, however, most of Florida has ready access to an abundant supply of underground water. In the vicinity of Fort Lauderdale it is available between 90 and 150 ft. deep, but usually it is high in organic color, very hard, and objectionable in taste and odor. Also, if the wells near the coast are pumped very hard the water often becomes too salty for use, although this condition will sometimes correct itself if the wells are rested for a sufficient period. The more distant the wells are from the coast, however, the less subject they are to salt.

In 1925, during the period of Florida's rapid development, the city obtained its water from two wells in the center of the city. After being softened with lime it was pumped by old and inadequate equipment through a very limited distribution system. With the rapid increase of population, the added draft on the wells resulted in the water becoming very salty, extremely discolored and almost impossible to treat; and along with the failure of the wells came the collapse of the equipment. A bond issue to provide for the construction of a new plant was authorized, but the situation became so acute that relief had to be provided while it was being built. This was accomplished through the erection of a temporary plant on the west side of the city, consisting of two 12-in. wells 100 ft. deep, equipped with air lift, and two motor-driven centrifugal pumps, each having a capacity of 1,000 gal. per minute. The water, being very hard and high in organic color, was treated with alum and lime in eight 100,000-gal. reinforced-concrete tanks and was then pumped from a central receiving reservoir to the distribution system. The temporary plant, which cost about $55,000, was completed in 90 days and afforded relief from the highly objectionable water of the old plant while the permanent plant was being designed and built.

In order to locate the new wells as far away from the ocean as possible without going into the Everglades, the new city golf course (about 7 miles inland and on the edge of the Glades) was selected as the site. This property covers about 208 acres; it is owned by the city and can therefore be controlled to avoid pollution.

Six 12-in. wells were drilled, with depths varying between 90 and 125 ft. In this section the water is found in the porous limestone. Near the surface, alternate layers of sand and muck are encountered overlying sand and limestone. These layers may be anywhere from a few inches to many feet in thickness. In each instance, because of the variations in thickness and depth of water-bearing rock, a pilot well was used to locate the water and to determine the extent of the rock strata. The well was then drilled so as to seat the casing into the rock and the hole was driven as far ahead of the casing as possible without breaking through into the next sand layer. This method succeeded in every instance in shutting out the sand and no trouble has been experienced with any of the wells.

The water in the golf course wells stands from 2 to 6 ft. below the surface and is delivered to an 18-in. cast-iron pipe collecting main by motor-driven centrifugal pumps with direct suction to the wells. To prevent the possibility of overdrafting and the taking in of salt water, the pump capacity at each well is limited to 400 gal. per minute. An attractive tile and stucco building houses the equipment at each well and also affords storm shelter to

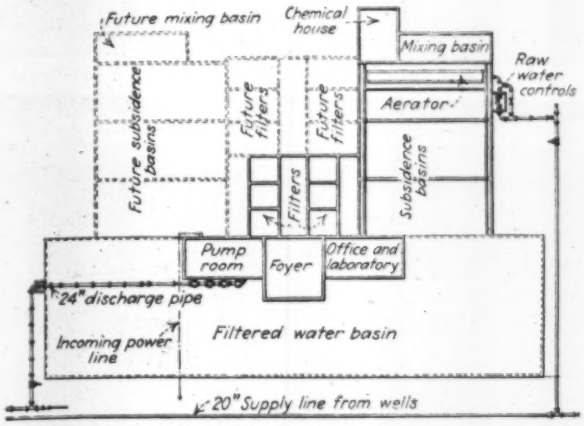

FIG. 2—GENERAL PLAN OF FORT LAUDERDALE WATER-TREATMENT PLANT

the golf players. In addition to the six golf-course wells, there are two more located on the ten-acre site of the filter plant. These are equipped with both electric and gasoline motors.

Because of the high color, disagreeable taste and hardness of the water, rather multiple treatment is necessary. The site selected for the treatment plant is about a mile in the direction of the city from the golf course. The location is the highest point in the county, 21 ft. above sea level, and is on the West Dixie Highway, connecting Palm Beach with Miami. It is above possible danger from flooding, is near the main plant of the Florida Power & Light Company, from which it obtains its power, and is also near the North New River Canal to Lake Okeechobee, into which it discharges its wash water. This canal is also considered to be a potential source for an additional supply of water should the demand ever exceed the well supply.

The plant consists of an aerator, a chemical house, mechanical mixing chambers, three coagulating basins, a carbonating chamber and six 1,000,000-gal. filters, in addition to the main building housing the filter operating room, the pump room for the high-service pumps, the laboratory, the workshop, the carbon dioxide generating plant, the office and a large foyer over which is located the wash-water tank. Under the filters and the main building and extending 75 ft. to the highway in front is the reinforced-concrete filtered-water storage reservoir of 2,500,000-gal. capacity with the section in front of the building covered with lawn and shrubbery. The chemical building, the mixing chamber and the aerator are located to the rear of the sedimentation basins. On exploring the foundations, pockets of saturated muck were found with the sand and rock and the bearing capacity often varied widely within a few feet. Because of this unsatisfactory condition, the filters, the main building and the clear-water storage reservoir are supported on piling.

The design provides for future extension on the unit system and another battery of sedimentation basins may be constructed when necessary, opposite the present ones on the other side of the filters. The filters may be extended in a straight line from the present installation to any desired capacity.

The water coming from the wells at the new city golf course, through a 20-in. cast-iron pipe, passes through the raw-water control house and is then led to the aerators. Aeration is effected by allowing the water to fall freely through the air in thin sheets a distance of about 8 ft. The aerators are located directly over one of the sedimentation basins adjacent to the chemical house.

The aerated water is led into the chemical house, where it is dosed with lime and alum. The chemical house is a three-story reinforced-concrete structure with stucco-covered tile walls. The first floor is used for storage and the second floor contains four dry-feed machines, two for alum and two for lime. The third floor is for chemical storage and has the tops of the steel hoppers for the dry-feed machines at floor level so as to facilitate the easy handling of chemicals. A hydraulic elevator opening to the driveway in the rear of the building carries the chemicals to the storage rooms. Lavatories and showers are provided on the second floor. The four dry-feed machines are set in a straight line immediately over the flume carrying water from the aerators to the mixing chambers. A run of only a few feet through the flume discharges the water into the mixing basins.

Mixing is accomplished by electrically operated rotating steel paddles. From the mixing basins the water passes through a short flume to the sedimentation basins

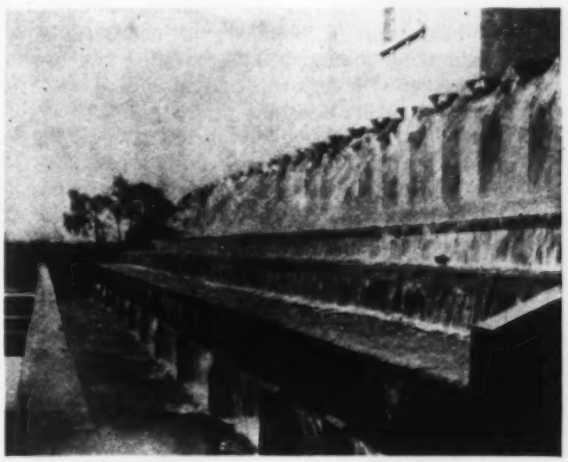

FIG. 3—AERATORS OVER SEDIMENTATION BASIN

which are arranged to operate in either parallel or series. Perforated baffles and weirs are provided at the ends of the basins, and connecting flumes are equipped with sluice gates to permit the easy cutting in or out of any unit.

In the carbonating chamber, into which the settled water is conducted, the carbon dioxide is distributed through a system of perforated wood pipes. The orifices all face downward, and to insure an even distribution of gas, the pipe is covered with a layer of gravel. The results have been extremely satisfactory. The use of gravel to secure distribution of gas is new, and it has proved very successful in giving even distribution of the gas throughout the chamber.

After carbonation the water passes to the filters, of which there are six, 18x20 ft. in area, rated at 1,000,000 gal. daily each. The operating floor is located immediately back of the foyer between the two batteries of filters. Four of the filters are now in operation; two of

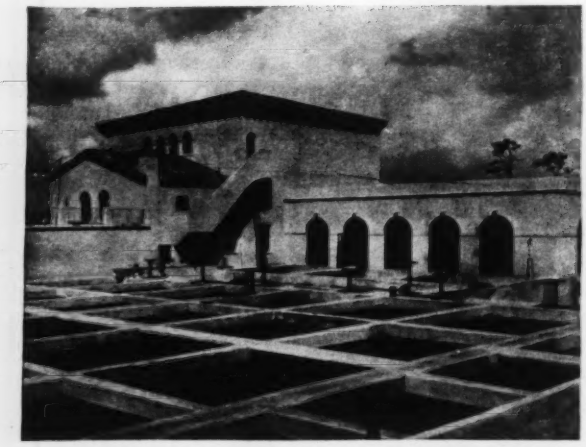

FIG. 4—VIEW ACROSS COAGULATION BASINS, SHOWING FILTER OPERATING ROOM AT RIGHT

them have not yet had the filter piping and filtering material installed. Operating tables are of slate and are equipped with sight samplers, loss-of-head gages and registers. French doors permit ready access to the walkways around all filters, and the tables are arranged so as to permit the operators to observe the action of filters during washing.

The pipe gallery is between the filters. The influent and waste-water conduits are of concrete, all others of cast iron. Each filter is equipped with a rate-controller and hydraulic sample pumps. The collecting system is of perforated cast-iron pipe, connected to special cast-iron tees set in the concrete floor and discharging into a concrete collector. The pipe gallery is roomy, well lighted and ventilated, with all equipment readily accessible. No stooping or crowding is necessary to work on any part of the equipment.

The filtered water is discharged directly into the clear-water well, which is baffled throughout with 4-in. tile walls to insure a constant and uniform circulation of water between the filters and pumps. The section of clear well below the filters can be cut off from the remainder by means of a sluice gate to permit cleaning or repairs. A cast-iron conduit is arranged so that water may be carried from this section direct to the pumps when the main reservoir is empty. This provides a workable storage reserve that can be utilized while the main reservoir is out of commission.

To the left of the foyer is the pump room, with a red quarry tile floor and plastered walls finished like the foyer. The equipment consists of a wash-water pump, two 1,000 gal. per minute, one 2,000 gal. per minute and one 3,000 gal. per minute motor-driven centrifugal pumps. Motors operate at 4,000 volts with pumps designed for 200-ft. head. The largest pump is equipped

FIG. 5—CHEMICAL HOUSE, AERATOR AND MIXING BASINS

with dual drive and has a 300-hp. gasoline engine as the auxiliary. Pump suction is direct from the clear-water well under the pump room, and all of the pumps discharge into a header just outside the building and on the roof of the clear well. Priming is effected by motor-driven vacuum pumps with hydraulic ejectors as a stand-by. During the 1928 hurricane when the electric power lines were damaged, the plant operated for four days on this auxiliary power. It was the only municipal water plant in the path of the hurricane that was not put out of commission. Aside from a few broken window screens, the plant suffered no damages and was a haven of refuge for more than 150 people from the neighboring Glades. During the construction the storm hazard was kept in mind and all designs were provided for extreme wind velocities.

To the right of the foyer is the wing containing the laboratory, the workshop and the carbon dioxide gas-generating equipment, in addition to locker rooms, lavatory and

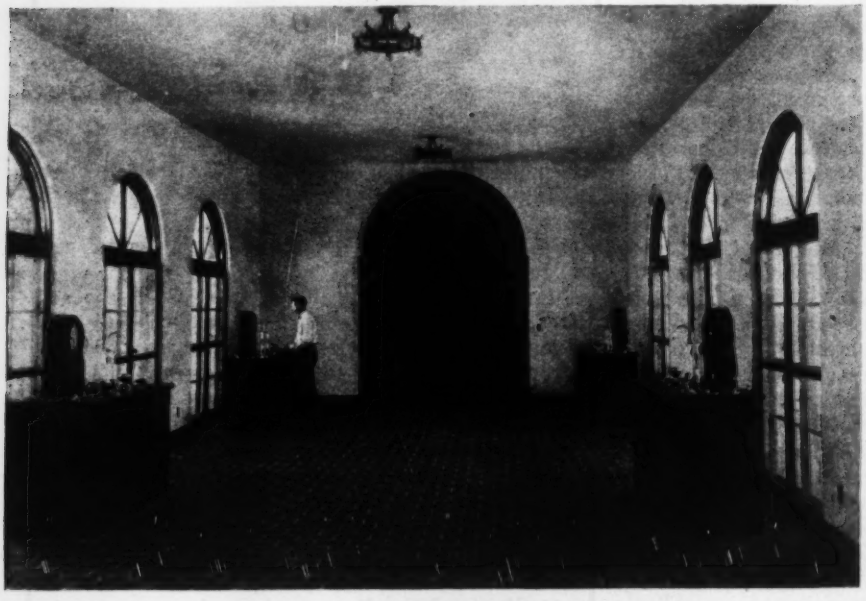

FIG. 6—FILTER OPERATING ROOM
View looking toward foyer. Wash-water tank overhead.

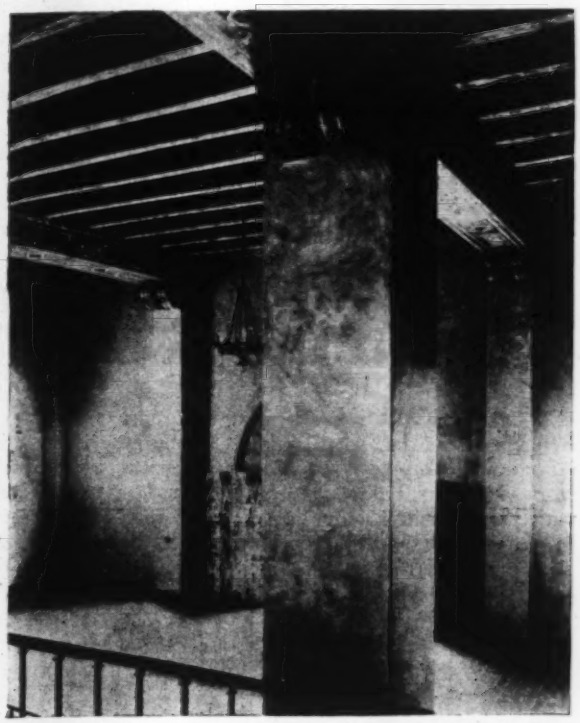

FIG. 7—INTERIOR OF ENTRANCE FOYER
Showing column with concealed piping from wash-water tank, and decorated cypress ceiling.

shower baths for the operators. On the second floor of this wing is the superintendent's office, overlooking the foyer and settling basins. The walls and ceiling are finished in cream color, and the concrete floor is covered with battleship linoleum.

As the city is growing rapidly in winter tourist popularity, it was decided to make the plant as attractive as possible. Architecture of the Spanish type was adopted so as to harmonize with the surroundings. The buildings are of steel, reinforced concrete, tile and stucco construction with Cuban tile roofs. The entrance foyer in the middle of the building is under the wash-water tank and is a spacious room 44 ft. square with 26-ft. ceiling. The floor is of red quarry tile, the ceiling of decorated pecky cypress, and the walls are of rough texture plaster finished in buff color with green tile trim. A balcony with ornamental iron railing extending across the rear of the room serves as a landing for the staircase leading to the filter operating room, conceals the influent flume and provides an entrance to the pipe gallery. Two massive columns in the center of the room incase the wash-water and overflow piping to the tank above. The lighting is from suspended heavy hand-wrought iron chandeliers.

The additional expenditure necessary to secure an attractive appearance was but a small percentage of the total cost and has more than justified itself from an advertising standpoint. Since the plant's completion it has been favored with a steady flow of visitors from all over the country. On Sundays and holidays it is sometimes necessary to place an additional attendant at the plant to act as a guide. The attractiveness, cleanliness and thorough treatment which the water receives have done much to create confidence in the city water supply. Until recently a disagreeable water has been accepted as a matter of course in this territory and a very satisfactory response has already been noticed in an increased interest in the city and its development.

The plant is operated by one man except during the day shift, when an assistant is on duty as janitor and gardener.

The hardness of the raw water is 310, with color of 48. After the water is treated the hardness is 85, and the color 10. The bacterial count from tap samples in the city very rarely exceed 1 per cubic centimeter; it usually is negative. Analyses are made every day by J. W. Cannon, the superintendent of the water-works, who reports that at no time since the plant was placed in operation has any gas or fermentation been found. Chlorine to the extent of 0.2 part per million is added after the water leaves the filters.

The effect of the carbon dioxide gas has been very noticeable in that it has almost eliminated trouble formerly experienced from the clogging meters and stuck valves due to deposits from the water. Before the introduction of the carbon dioxide, the meter department had to repair an average of 100 meters per quarter. Since the gas has been used, the meter repair work has been reduced to five or six meters per quarter, and the trouble occurring from stuck valves has been practically eliminated.

FIG. 8—LAYING 18-IN. FLEXIBLE JOINT PIPE ACROSS LAS OLAS SOUND

In addition to the pumping station and the filter plant, the project included a 24-in. cast-iron supply main 4 miles in length to the main section of the city, where it discharges into two 16-in. mains. These, in turn, are interlocked with the distribution system, comprising 40 miles of new mains.

The city is divided by New River, a stream varying in depth from 25 to 45 ft., and by Las Olas Sound. It was necessary to cross New River with two 16-in. mains and one 12-in. main, and Las Olas Sound with a 16-in. main. These crossings were accomplished with flexible joint pipe. The trenches leading to the river crossings, and the river bottoms, were excavated to grade by a dredge and the pipe was calked on the bank and pulled forward as fast as each length of pipe was finished.

At Las Olas Sound crossing, in order to comply with government requirements, the trench was excavated in rock to a depth of 16 ft. below mean low water by means of blasting and a dipper dredge. The pipe was laid from a wooden cradle suspended between two scows. After being calked, the scows and the cradle were moved forward with tugs and cable moorings, causing the newly calked sections to slide into place length by length. The current at all crossings, due to tide, was very swift and it was extremely difficult to hold the barges and equipment in line. In one instance a tow composed of barges broke away from the tugboat and crashed into the pipe-laying outfit. The pipe, scows, and cradle were carried about 50 ft. off line before control was regained. Although the pipe had been moved and had to be returned to its original alignment, inspection showed that it had suffered no damage, and it was not necessary to do any additional work on it.

All pipe was subjected to test for leakage after laying and special attention was given to the water crossings. They all proved good within allowable limits and after a year's service are in perfect order.

All joints, except those at the river and sound crossings, were made with leadite. The specifications limited permissible leakage under 24-hour test at 100 lb. pressure to 200 gal. per inch of pipe diameter per mile per day. Final tests were made on the lines generally about 30 days after the joints had been poured and the leakage averaged from 20 to 25 per cent of the above allowance.

The Southeastern Board of Fire Underwriters has recently given the city Class A rating, which carries with it a substantial reduction in insurance rates. The temporary water plant has not been dismantled but is used as a stand-by and the city receives a considerable credit in its rating because of this reserve supply. This plant has, therefore, served a twofold purpose, first in providing a water supply while the new plant was being built and now as a reserve or emergency supply.

The work was designed and supervised by Solomon, Norcross & Keis, Inc., consulting engineers, of Atlanta, Ga., and Troy, N. Y. The Andrews-Fay Construction Company, of Cleveland, Ohio, was the general contractor on the filter plant and pumping station, and the Federal Construction Company of Birmingham, Ala., with George B. Weaver in charge, was the contractor on the supply main and distribution system. DeLaval pumps with Westinghouse motors are used and were furnished through Burford, Hall & Smith, of Atlanta. The filter equipment was installed by the American Water Softener Company, of Philadelphia.

The cost of the filter plant and pumping station complete with eight wells was $517,000, and the cost of the supply main and distribution system was $800,000. Stanley E. Arnold was resident engineer on the construction of the water-treatment plant, and J. F. Henderson was in charge of the supply main, distribution system and river crossings.

Pioneer Tests of Aluminum Beams Reveal Good Structural Qualities

I-Sections Support 13 Per Cent More Load Than Steel of Same Size and 130 Per Cent More Load Per Pound of Weight

By R. L. Templin and E. C. Hartmann

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In connection with a program of structural tests in progress at the research laboratory of the Aluminum Company of America, some preliminary work on aluminum alloy I-beams has been completed, with results that should prove of interest to engineers in general. The tests referred to were made on six aluminum and four steel specimens 10½ ft. long, whose cross-sections are illustrated in Fig. 1. Table I gives

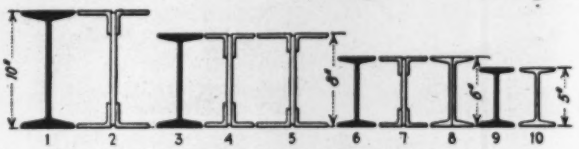

FIG. 1—SPECIMENS USED IN TESTS OF ALUMINUM ALLOY BEAMS
Shaded sections are steel.

the sizes of material used and the scale weights and moments of inertia of the various beams. The steel specimens were included for purposes of comparison.

The aluminum beams ranged in depth from 10 to 5 in., and were all made from 17ST, one of the heat-treated strong aluminum alloys. The plates were rolled, the angles, channels and I-beam extruded. These extruded shapes are standard products made to correspond in all dimensions to standard steel shapes. The channels of beam 8, for example, are nominally the same in all dimensions as 6-in. steel channels weighing 8.2 lb. per foot.

Beams 2, 4, 5, 7 and 8 were riveted with ⅜-in. steel rivets driven hot. Contrary to what might be expected, this procedure does not noticeably affect the strength of heat-treated strong alloy structures. But it is not necessary to use steel rivets in this type of construction. Since the completion of the tests described in this article, the technique of driving strong-alloy rivets has been developed to such a stage that it is now feasible to use

TABLE I—DIMENSIONS, WEIGHTS AND MOMENTS OF INERTIA OF BEAM SPECIMENS

Beam No.	Nominal Depth, In.	Material	Section Used	Total Weight of Beam, Lb.	Nominal I In.⁴	Actual I In.⁴
1	10	Steel	Standard rolled I	268.5	122.1	120.9
2	10	Aluminum	1 plate 9½x⅜ in. 4 angles 3x2x½ in.	121.5	132.1	....
3	8	Steel	Standard rolled I	192.5	56.9	57.1
4	8	Aluminum	1 plate 7½x½ in. 4 angles 2x2x— in.	102.5	69.1	....
5	8	Aluminum	1 plate 7½x½ in. 4 angles 3x1½x½ in.	97.0	72.1	....
6	6	Steel	Standard rolled I	129.5	21.8	21.8
7	6	Aluminum	1 plate 5½x⅜ in. 4 angles 2x1½x½ in.	70.5	27.3	....
8	6	Aluminum	2 extruded channels at 2.9 lb. per ft.	69.0	26.0	27.0
9	5	Steel	Standard rolled I	102.5	12.1	11.7
10	5	Aluminum	Standard extruded I	38.5	12.1	12.7

practically all sizes common to structural work. The largest size in actual use to date is ¾ in., but experimental work has shown that larger sizes can be used.

Table I gives the nominal moments of inertia, either taken from a handbook or computed from the nominal dimensions, using the gross section. The actual moments of inertia were obtained for beams numbered 1, 3, 6, 8, 9 and 10 by tracing the section on cardboard from a slice of the beam and going over this diagram with a mechanical integrator. The beams for which this was not done are those built up of plates and angles. In these cases the nominal moment of inertia based on gross area was used in all computations, while in the other cases the actual moment of inertia was used. It is interesting to note that there are considerable differences, both plus and minus, between nominal and actual moments of inertia.

A number of samples of material were taken from each of the various beams and tested to determine their mechanical properties. It will be noted in Table II that

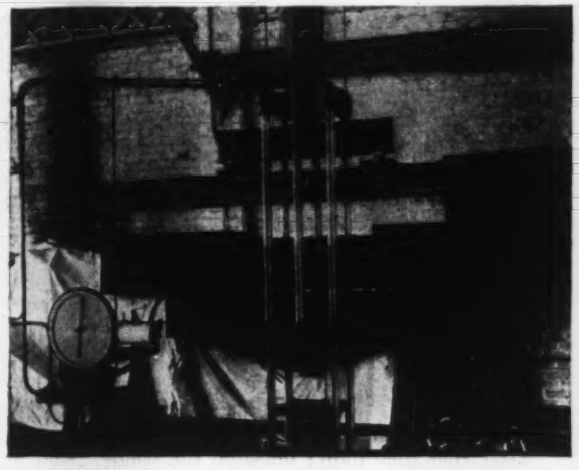

FIG. 2—ALUMINUM ALLOY BEAM IN TESTING MACHINE
Load was applied at the third-points. All failures were by buckling of top flange at or between load points.

the steel specimens were well up to the standard of strength of rolled structural steel, averaging somewhat higher properties than the strong aluminum alloy specimens, as would be expected.

Each of the beams was tested on a span length of 10 ft. in a 100,000-lb. testing machine. The load was applied at the third-points of the span length by an auxiliary loading beam as shown in Fig. 2. In each case the beam failed by gradual sidewise buckling of the top flange at or between the load points.

Table III shows the ultimate loads carried by the various beams; the last column gives the values of the maximum stress at failure, computed by substituting the ultimate load in the ordinary beam formula,

$$P = \frac{Mc}{I} = \frac{PL}{6S}$$

These, of course, are not necessarily the true maximum ultimate stresses in the beams, but they are of interest inasmuch as they provide a means of comparing the ultimate strengths of the various beams in terms of their relative sizes and moments of inertia.

It is apparent from Table III that the aluminum beams compared very favorably in strength with the steel beams. They averaged only about half the weight of the steel beams and carried on the average 13 per cent more load.

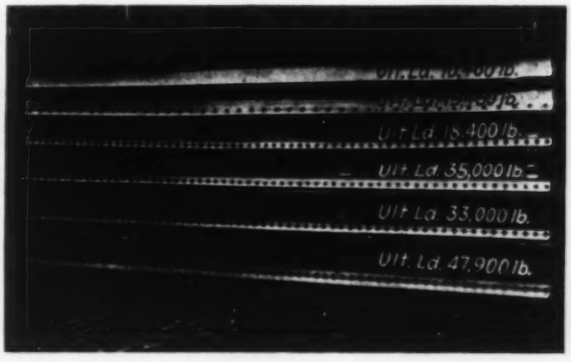

FIG. 3—ALUMINUM ALLOY BEAMS AFTER TESTING TO FAILURE
Note that beams are not badly warped. Reading down, the beams shown are numbers 10, 8, 7, 4, 5 and 2 of Fig. 1.

In order to compare the strengths of the different beams on the basis of weight, Table IV has been prepared. This table shows the load carried per pound of weight, a figure obtained in each case by dividing the ultimate load by the total weight of the beam. These figures demonstrate that for each depth the aluminum beams carried, on the average, 130 per cent more load per pound of weight than the corresponding steel beams. For example, the 10-in. aluminum beam carried 2.32 times as much load in proportion to its weight as the 10-in. steel beam. The 8-in. aluminum beams each carried 2.33 times as much load in proportion to its weight as the 8-in. steel beam. It is remarkable that this ratio is so nearly a constant when it is considered that the aluminum beams were of different types.

Fig. 4 is typical of the deflection curves obtained in these tests. The 5-in. beams were chosen because they

TABLE II—AVERAGE MECHANICAL PROPERTIES OF MATERIAL IN BEAM SPECIMENS

Beam No.	Material	Tensile Strength, Lb./Sq.In.	Yield-point, Lb./Sq.In.	Elongation in 2 In., Per Cent	Modulus of Elasticity, Lb./Sq.In.	Brinell Hardness*
2	Aluminum	57,800	41,700	22.4	9,980,000	110.3
4	Aluminum	58,500	42,900	21.2	10,220,000	111.8
5	Aluminum	55,400	39,800	24.4	10,070,000	110.5
7	Aluminum	57,100	40,200	25.4	10,380,000	109.6
8	Aluminum	62,300	42,100	18.6	10,260,000	107.4
10	Aluminum	62,500	42,500	18.9	10,270,000	104.8
1	Steel	63,700	39,200	32.0	30,510,000	120.8
3	Steel	64,700	39,200	31.0	29,970,000	120.5
6	Steel	63,600	43,100	26.4	28,680,000	118.3
9	Steel	77,100	49,700	24.6	29,300,000	144.0
Average of Aluminum specimens..		58,900	41,500	21.8	10,200,000	109.1
Average of steel specimens.....		67,300	42,800	28.5	29,610,000	125.9

*500 kg. on 10-mm. ball.

TABLE III—COMPARISON OF STRENGTH OF THE VARIOUS BEAMS

Beam No.	Nominal Depth, In.	Material	Ultimate Load, Lb.	Computed Ultimate Stress, Lb. Per Sq.In.
1	10	Steel	45,650	37,700
2	10	Aluminum	47,900	36,200
3	8	Steel	28,100	39,400
4	8	Aluminum	35,000	40,500
5	8	Aluminum	33,000	36,600
6	6	Steel	15,500	42,700
7	6	Aluminum	18,400	40,400
8	6	Aluminum	19,450	43,200
9	5	Steel	11,850	50,600
10	5	Aluminum	10,400	40,900

TABLE IV—LOAD WEIGHT RELATION FOR THE VARIOUS BEAMS

Beam No.	Nominal Depth, In.	Material	Load Carried Per Lb. of Weight
1	10	Steel	170
2	10	Aluminum	394
3	8	Steel	146
4	8	Aluminum	340
5	8	Aluminum	340
6	6	Steel	120
7	6	Aluminum	261
8	6	Aluminum	282
9	5	Steel	116
10	5	Aluminum	270

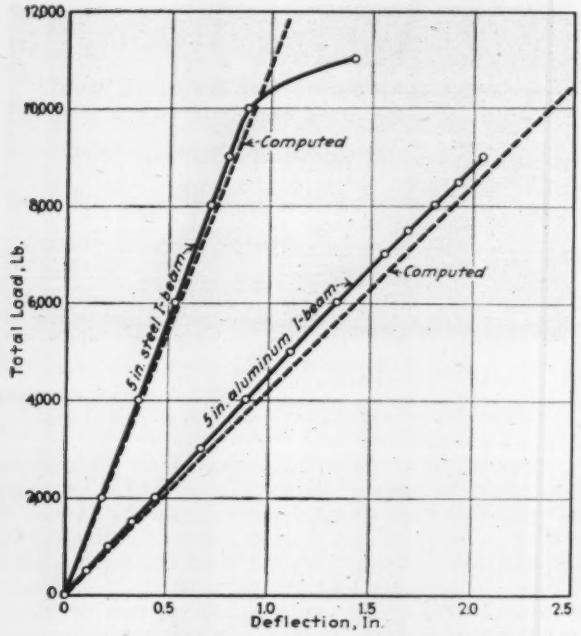

FIG. 4—LOAD-DEFLECTION CURVES FOR STEEL AND ALUMINUM-ALLOY BEAMS

are nominally the same in all dimensions and give a better opportunity for direct comparison. It is clear from a study of these curves that the aluminum beam deflected about 2½ times as far as the steel beam for any given load. This ratio of deflections is about the inverse of the ratio of the *EI* values for the two beams, as would be expected.

The load-stress curves for the 10-in. beams, shown in Fig. 5, are plotted from the average of readings on several gage lines in the center section of the beam. These readings were taken with a 2-in. strain gage and were translated into stresses in accordance with the average stress-strain relations for the metal in the beam as determined by the tests of samples. The computed stresses indicate the results of substituting in the beam formula previously mentioned, gross moment of inertia being used for the built-up beam. Comparing the curves for the steel and aluminum beams, it is evident there is little difference between the relation of the measured to the computed stress in the two cases. The stress data from the other beams showed similar results.

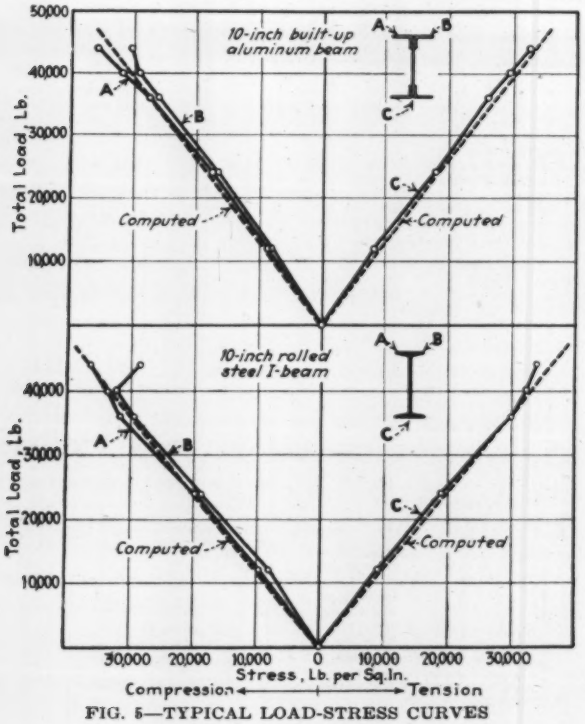

FIG. 5—TYPICAL LOAD-STRESS CURVES

The tests described here were of a preliminary nature and are being supplemented by further tests along the same lines. The ultimate aim of this work is to provide a basis for a set of specifications to guide designers in the use of structural aluminum. In the meantime it is of interest in showing what may be expected of rolled strong-alloy shapes, now being produced commercially.

A Contractor's Views on Welding

"MY MEN were rivet men, antagonistic to anything welded because it looked as if welding was taking work away from them. As a result they decided they were going to find out how good this building was, and at every opportunity they would try to break off some of the welded angles or seats. For instance, instead of putting a choker around a column to pick it up, they would shackle in a hole in one of the clip angles. They expected to pick these off like you would huckle burrs. But they didn't come off."

The foregoing is from a paper presented at a meeting of the International Acetylene Association by G. C. Holcombe, of Forestville, N. Y., who erected the steel on the building at the Niagara Falls plant of the Union Carbide Company. (*Engineering News-Record*, Dec. 12, 1929, p. 928.) Mr. Holcombe also related how a 225 lb. steelworker attempted to knock a connection plate from a spandrel with a maul and succeeded only in bending the plate.

"After that they didn't question the welds," said Mr. Holcombe, "and they began figuring out that maybe there was something to this welding after all." And he continued, "This welding business has come to the point where it is a matter of education and getting the costs in shape so you can meet the competition with rivets. So far as the safety of erection is concerned, that is due entirely to the men who design and fabricate the welding before it comes to the job, for if those who designed it did not study the erector's side, it might not go together economically and safely. They have got to use a little judgment and fabricate the building in such shape that it can be handled somewhat as a riveted building. You must have enough bolts to hold it in shape so it may be plumbed and squared ready for the welding."

European Cities Consider Subway Construction

Two cities in Europe are contemplating construction of subways as a means of relieving traffic congestion and expediting travel. In Rome, Italy, the Italian Superior Council of Public Works has accepted a report recommending the construction of three subway lines aggregating over 15 miles in length at an estimated cost of approximately $38,000,000. In Stockholm, Sweden, plans are being considered for the construction of a two-track subway from 3 to 4 miles long, running north and south under the city and connecting suburbs on either side. This would cost approximately $18,760,000, according to preliminary estimates.

Two High Traveling Towers With Chutes Place Concrete on New Brunswick Multiple Arch Bridge

Three-Hinged Steel Trusses Used for Centering on 202-Ft. Arch Ribs on High Level Crossing Over Raritan River—Celluloid Models Check Design and Determine Location of Expansion Joints

By Morris Goodkind
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FIG. 1—AIR VIEW OF RARITAN RIVER BRIDGE, NEW BRUNSWICK, N. J.

DESIGN and construction methods in the building of a new highway bridge over the Raritan River near New Brunswick, N. J., depart sufficiently from ordinary procedure to warrant some discussion of them. In the design work a complete celluloid model of the bridge was made for the purpose of checking calculations with deformeter gages. Other models were used to determine the location and number of expansion joints in the bridge floor. In the construction operations two traveling towers 160 ft. high, carrying counterweight chutes, handled most of the 74,000 cu.yd. of concrete required for the bridge. For the construction of the three ribs on each of the six 202-ft. arches, centers consisting of three-hinged, self-supporting steel trusses were used.

The bridge is located about two miles east of the center of New Brunswick on state route No. 25, the new highway being built from the Holland tunnel in Jersey City to the Philadelphia-Camden bridge in Camden, avoiding all large centers of population and eliminating all railroad grade crossings and many important highway grade crossings. The present route through New Brunswick crosses on a low level bridge at Albany St. Traffic over this bridge averages 24,000 vehicles daily, with a peak load of 2,000 per hour, plus frequent movement of double-track trolley service. As the structure also crosses the Delaware and Raritan Canal at low level, frequent drawspan openings have created an almost intolerable traffic congestion.

At the location of the new bridge the river is navigable with a minimum channel depth of 10 ft. in low water, and consideration is now being given by the War Department to increasing this depth to 15 ft. Studies were made both of the low-level bridge with a drawspan over the channel and a high-level fixed bridge. The high-level crossing was finally decided upon, because of the interference to traffic that would be caused by bridge openings and because of the objection of navigation interests to a low-level crossing. The federal permit issued for the construction of the new structure called for a vertical clearance above the mean high water of 100 ft. at the center line of the channel, and for a minimum clearance of 90 ft. for a distance of 25 ft. each side of the center. The clear width of opening over the channel was fixed at 200 ft. By locating the bridge between two knolls at El. 95 and using two intersecting 2 per cent grades on a vertical curve the required clearance over the channel was obtained.

The bridge consists of six 202-ft. open spandrel arches, flanked by four 40-ft. barrel arches on the north end and five similar spans on the south end (Fig. 2). The barrel arches, semicircular and cinder filled, are covered with a membrane waterproofing with 1-in. mortar protection. The structure is 1,902 ft. long and carries a 50-ft. roadway and two 6-ft. sidewalks, protected by reinforced-concrete balustrades. The roadway over the main span is paved with sheet asphalt, while a temporary bituminous pavement has been placed over the cinder-filled approaches.

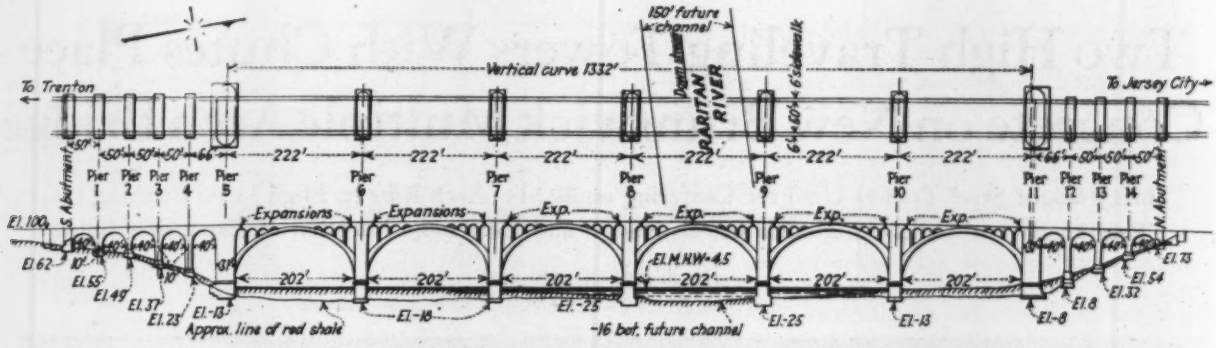


FIG. 2—PLAN AND ELEVATION OF RARITAN RIVER BRIDGE

Each of the main arch spans consists of three hingeless ribs, 12 ft. wide, designed as free ribs by the application of the elastic theory without taking into account the restraining action of the superstructure. The design was checked by the use of deformeter gages on a celluloid model, and the agreement with the analytical method was practically exact. A determination of the stresses in the rib was also made on a complete model of the rib and superstructure, and marked reductions in the moments, thrusts and shears were noted due to the stiffening effect of the spandrels and floor. However, since

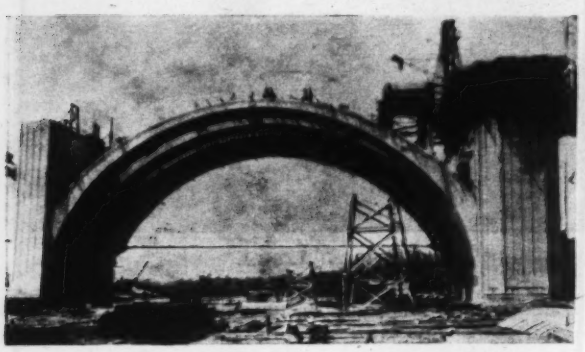


FIG. 3—ARCH RIBS SHOWING STEEL CENTERING IN PLACE

the superstructure was poured after the centering was struck, it does not relieve the rib of any of its dead load stresses. The braced condition of the rib is applicable under live load, but as the live-load stresses comprise but a small proportion of the total, no advantage was taken of the reduced stresses in a redesign of the rib.

Interesting experiments were conducted on celluloid models of the entire span to determine the number and location of expansion joints in the floor. One model was prepared with joints in the floor adjacent to the piers. The temperature effect on the length of span was obtained by moving one of the abutments horizontally and measuring the relative changes in the width of the joints. Similar measurements were taken of two additional joints cut in the model adjacent to the crown. It was found that the movement of a joint near the crown was only about 16 per cent of that in the joints near the piers and were opposite in effect—that is, for a rise in temperature the crown joints would open, due to rotations of the spandrel columns caused by the rise in the rib. It was also found that the algebraic sum of the movements in the four joints was equal to the sum of the movements of the two joints at the piers in the original model. On the basis of these tests, only the joints at the piers are being used, with the assumption that the slight horizontal movement that may take place near the crown will be dissipated by means of the reinforcing steel.

All of the piers were carried down into solid shale rock with a maximum foundation pressure of 10 tons per square foot. Piers 5 and 11 were designed as abutment piers, and pier 8 was also designed as an abutment for construction purposes. Piers 8 and 9 were carried down to El. —25 to provide for future dredging of the channel, and all of the piers are faced with granite for a depth of 14 ft. for protection.

Rib Design—The ribs were designed for a uniform live load of 150 lb. per square foot on the roadway and 75 lb. per square foot on the sidewalks, without any additional allowance for impact. Each rib is poured in seven voussoir blocks symmetrically about the crown, and separated to permit the later pouring of 4-ft. key blocks. The arch reinforcing is lapped in these key sections and permits the free movement of the bars during the shrinkage of the voussoirs and the deformation of the centering. The key blocks are poured five days after the completion of

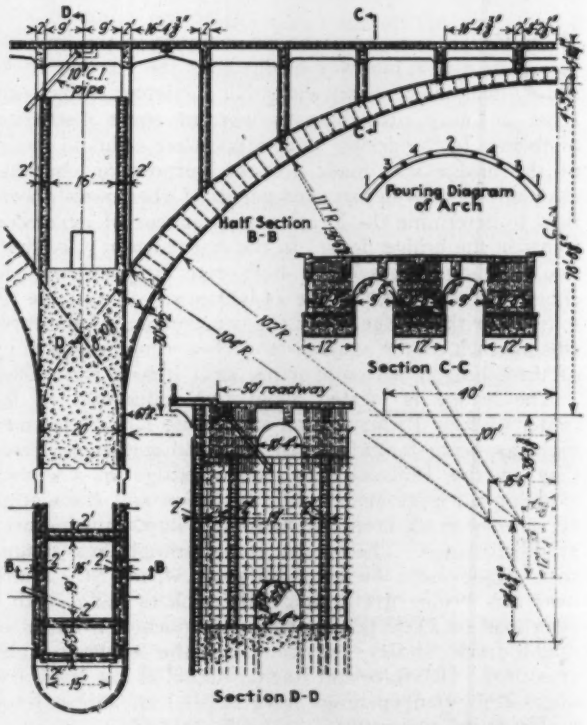


FIG. 4—HALF-SECTION OF ONE OF MAIN SPANS SHOWING DETAILS OF ARCHES AND PIERS

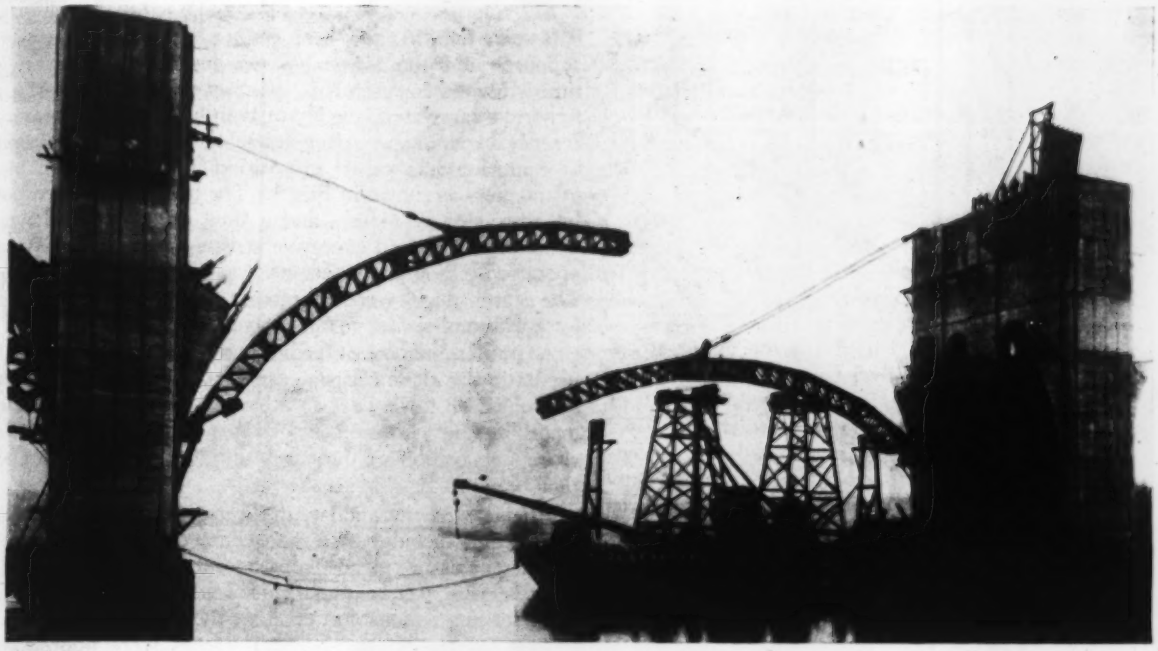


FIG. 5—ERECTING STEEL ARCH CENTERS OVER CHANNEL SPAN
Land spans erected similarly, using wooden towers the same as shown on barge.

the main sections, and the centering is struck 21 days after the completion of the entire rib. Details of the rib, deck and pier design are shown in Fig. 4.

The west rib of span 10, which was the first rib poured, is being used as a test for field measurements of the strains and movements due to load and temperature changes. By a complete installation of electric telemeters and temperature coils, as well as by mechanical strain gages, clinometer and deflection readings, and the measurement of longitudinal movements due to temperature changes, it is hoped that results of value to the designer of fixed concrete arches will be obtained.

Concrete Mixtures—The concrete proportions were specified as follows: footings for main piers and retaining walls and main piers up to springing line, Class D, 1:3:5, with a minimum strength of 2,600 lb. per sq.in.; retaining wall superstructure and approach piers up to springing plane, Class C, 1:2:4, 2,800 lb. per sq.in.; arch barrels, arch ribs and superstructure, Class B, 1:2:3½, 3,000 lb. per sq.in.; handrails, pylons and lamp standards, Class A, 1:1½:3, 3,000 lb. per sq.in.

The contract was awarded in April, 1928, for $1,509,473, with completion specified within eighteen months. The major quantities are as follows:

Foundation excavation	23,000 cu.yd.
Concrete	74,000 cu.yd.
Reinforcing steel	2,400 tons
Granite facing	1,500 cu.yd.

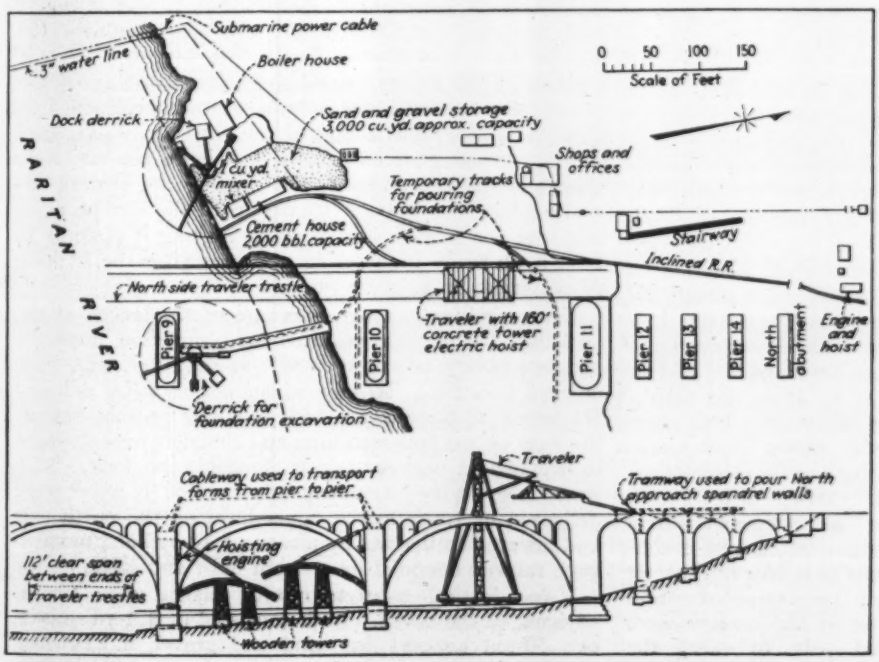


FIG. 6—CONTRACTOR'S PLANT LAYOUT
Only north half of job shown. Similar plant layout located on south side of river.

Excavation—Though the excavation for all piers was carried into bedrock, very little water was encountered, and with the exception of piers 6, 7, 8 and 9, no sheeting was required. Piers 6 and 10 were excavated with steam and gas cranes, while piers 7, 8 and 9 were excavated by electrically operated stiff-leg derricks on falsework piling. All of the remaining piers and the two abutments were excavated with steam shovels.

Centering—The ribs of the main spans were erected on steel centers designed as three-hinged trussed arches, three sets of centering being

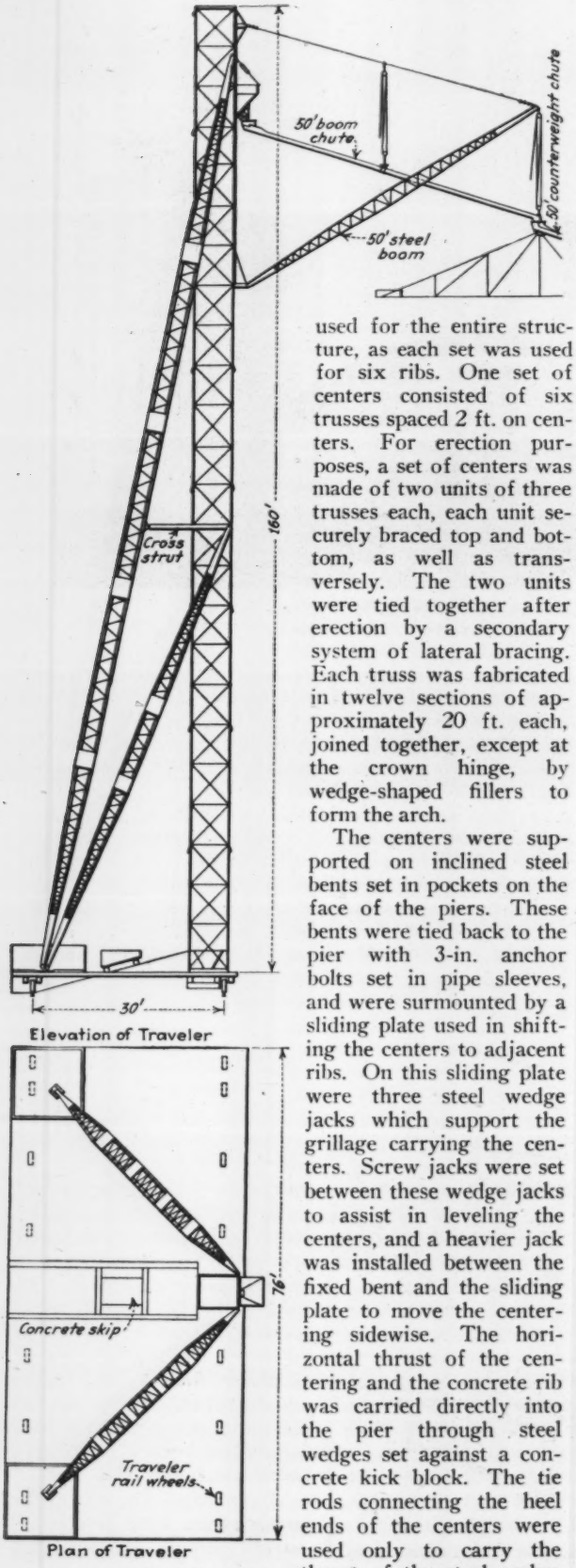


FIG. 7—TRAVELING CONCRETE TOWER

used for the entire structure, as each set was used for six ribs. One set of centers consisted of six trusses spaced 2 ft. on centers. For erection purposes, a set of centers was made of two units of three trusses each, each unit securely braced top and bottom, as well as transversely. The two units were tied together after erection by a secondary system of lateral bracing. Each truss was fabricated in twelve sections of approximately 20 ft. each, joined together, except at the crown hinge, by wedge-shaped fillers to form the arch.

The centers were supported on inclined steel bents set in pockets on the face of the piers. These bents were tied back to the pier with 3-in. anchor bolts set in pipe sleeves, and were surmounted by a sliding plate used in shifting the centers to adjacent ribs. On this sliding plate were three steel wedge jacks which support the grillage carrying the centers. Screw jacks were set between these wedge jacks to assist in leveling the centers, and a heavier jack was installed between the fixed bent and the sliding plate to move the centering sidewise. The horizontal thrust of the centering and the concrete rib was carried directly into the pier through steel wedges set against a concrete kick block. The tie rods connecting the heel ends of the centers were used only to carry the thrust of the steel arches while being moved.

Erection of Centering—In assembling the centering in half-span lengths, the heel ends were set on the pier supports and the adjoining sections balanced on two timber towers for each half-span, set to proper elevations to permit complete assembly of both halves without interference in lapping. After assembling, each half-section of centering was raised to position by hoists set on top of the piers as shown in Fig. 5. The hoists were operated by 3-hp. electric motors and a slow uniform speed was maintained to avoid excessive stresses during the lifting operation. Side guys were used as an added precaution. The center hinges were not pinned, but were held together by a ball-and-socket arrangement.

A similar method of erecting the arch centering was used for the channel span, except that the trusses were assembled on towers set on a barge. Due allowance was made in the elevation blocks to compensate for the changing position of the barge due to varying loads and tidal action.

All piers of the main spans were completed for their full height, including the umbrella sections, to the theoretical springing planes before centering for their respective ribs was begun. This was done to permit the piers serving as masts in erecting the centers.

The barrels of the approach arches were poured on timber truss centering supported on beams set temporarily on the piers at the springing lines. This centering and lagging was carefully fabricated of seasoned lumber and one set served for the construction of the nine spans quite satisfactorily.

Rib Forms—At the ends of each section of centering trusses a 4x10-in. timber, and at all intermediate panel points a 6x10-in. timber, was fastened to the trusses. These formed the support for sets of wedges of varying thicknesses. On these wedges and placed transversely to the trusses were 8x8-in. timbers sufficiently long to extend beyond the ribs for a footwalk. On these 8x8-in. timbers 4x8-in. stringers were laid flat on 1-ft. centers and drawn down to the contours of the intrados by four bolts at each panel point, countersunk in the stringers and connected to the top chord angles of the trusses. On top of the stringers was placed 2-in. lagging. A 4-in. camber at the crown provided for deformation of the trusses due to dead loads and temperature variation. As a precaution against sliding of the voussoir blocks, steel struts, consisting of two 6x4x$\frac{3}{8}$-in. angles per rib, were placed in the key sections. In shifting the centers laterally all of the wooden frames, with the exception of one side form, were left in place, making it possible to have a rib ready for pouring five days after the striking of centers of an adjacent rib.

Concrete Plant Layout—Because of the length of the structure and the time required for completion, duplicate concrete plants, one on each side of the river, were considered desirable. To take advantage of water delivery for nearly all materials, a dock was built on each side of the river on the bulkhead lines and channels were dredged to provide the necessary draft alongside the dock. Such items as could not be conveniently handled by water were delivered by truck to the upper level on the north side and lowered to the site by means of an inclined narrow-gage railway operated by a steam hoist and cable.

Two identical concrete mixing plants were located adjacent to the docks. Each consisted of a 1-yd. mixer, two 50-ton hoppers for sand and gravel, a 2,000-bag cement storage house, and storage space for approximately 3,000 cu.yd. of aggregate. All of the concrete

materials were delivered directly to the mixing plant or to the storage pile from scows by a steam-operated stiff-leg derrick. Concrete was handled from the plant by steel hopper cars driven by narrow-gage gasoline locomotives. The same layout that handled the concrete was used in removing excavated material, which was deposited to raise the area required for construction operations above the high water level. Fig. 6 shows the plant layout on one side of the river.

Concreting—The concrete was batched by volume, and mixed for 1½ minutes.

Piers 5, 10 and 11, below the coping, were concreted with 1-yd. bottom-dump buckets delivered on flat cars and handled by cranes. Piers 8 and 9, below the springing line, were poured with the same bottom-dump buckets handled by the electric derrick that did the excavating.

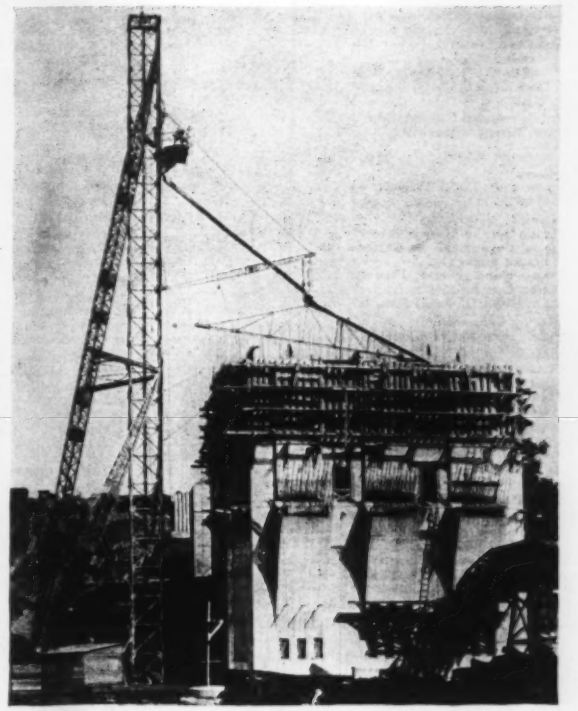


FIG. 8—VIEW OF NORTH SIDE TRAVELER IN OPERATION

All of the remainder of the concrete was handled by two traveling cranes, one on each side of the river.

The travelers consist of a steel frame tower, 160 ft. high, mounted on a platform traveling on a 30-ft. gage track (Fig. 7). The towers were braced to the platforms by two sets of structural steel stifflegs. Mounted on each tower was a 50-ft. boom chute and a 50-ft. counterweight chute. The concrete was brought to the traveler in steel hopper cars, and dumped into a skip, which in turn dumped into the tower hoist bucket. The entire traveler is electrically operated. The wide tracks upon which the travelers moved extended out into the river on trestles, but a clear space of 112 ft. was left between the ends of the trestles for the navigation channel. The traveling towers proved very flexible and were easily handled.

The spandrel walls on the cinder-filled approach arches were poured from cars on a narrow-gage track supported on the barrels. Concrete was delivered to the cars from the towers.

The superstructure for each main span was poured in five sections, symmetrical about the crown.

Pony bents set on each pier carried cableways that were used for transporting forms, steel and other materials for the superstructure.

Personnel—The bridge was built by the State Highway Commission of New Jersey. W. C. Sloan was state highway engineer until Aug. 1, when he was succeeded by Jacob L. Bauer. The design and construction of the bridge was under the supervision of the author as bridge engineer for the commission. L. C. Petersen was chief draftsman, and W. R. Ketels resident engineer for the commission. Parker & Graham, Inc., Paterson, N. J., was general contractor, with Duncan MacDonald as superintendent.

Federal and State Agencies Dealing With Water Resources

Departments With Power to Inspect, Regulate or Supervise Use of Water for Various Purposes or Build Control Works

By W. S. Conant

American Engineering Council Committee on Water Resources and Control, Washington, D. C.

AMERICAN ENGINEERING COUNCIL has on several occasions felt compelled to speak for its wide membership in the engineering profession either for or against proposed water-control legislation. In some cases jurisdiction seemed dubious. In others the regulatory authority proposed seemed to extend beyond the areas intended for such control. Not only was co-operation between adjoining areas found wanting but the identity of the body with which co-operation should be sought was sometimes doubtful.

To lay a foundation for future constructive work, it was apparent that an index should be made of the authority, both federal and state, through which construction in the entire field of water resources was undertaken and under which powers of investigation, regulation and supervision in any projects are exerted. After collecting some of these data, the work of compilation was intrusted to the Research Service, Inc. The resulting tables, herewith published, were compiled by A. B. McDaniel, secretary-treasurer of that organization.

FEDERAL AND STATE CONTROL OF WATER RESOURCES BY AGENCIES AND POWERS

The states are grouped geographically in accordance with an arrangement used by the Water Resources Branch of the U. S. Geological Survey. The seven columns deal successively with Navigation, Water Power, Irrigation, Drainage, Flood Control, Stream Pollution and Dam Inspection. The four symbols used have the following indications:

i—Investigatory: Power of making surveys, examinations, and the collection, compilation and publication of data in the form of reports and recommendations.

r—Regulatory: Power of regulating private action by the issuance and enforcement of rules, regulations and orders, which under existing laws may be enforced against private individuals or corporations.

s—Supervisory: Power of supervising and co-operating with local public or quasi-public authorities or bodies.

c—Construction: Power of expending money for improvements or for any construction work for the public welfare.

Federal Agencies	Nav.	W. P.	Irr.	Dr.	Flds.	Poln.	Dams
Department of Agriculture:							
Experiment Stations	....		i	i	....	....	.....
Forestry Service	....	r	r	....	ir	....	.....
Weather Bureau	i	....	....	....	i	....	.....
Bureau of Public Roads Division of Agricultural Engineering	....	....	i	i	....	....	.....
Department of Commerce:							
Bureau of Navigation	ir	....	....	....	....	....	.....
Bureau of Lighthouses	c	....	....	....	....	....	 c

Federal Agencies:	Nav.	W. P.	Irr.	Dr.	Flds.	Poln.	ams
Steamboat Inspection Service	*ir*	....	....	....	....	....	....
Coast and Geodetic Survey	*i*	....	....	....	....	....	....
Bureau of Foreign and Domestic Commerce	*i*	....	....	....	....	....	....
Department of the Interior:							
Bureau of Reclamation	....	....	*ic*	....	....	....	....
Geological Survey	....	*is*	*is*	....	....	....	....
General Land Office	....	....	*r*	....	....	....	....
Treasury Department:							
Customs Service	*r*	....	....	....	....	....	....
Coast Guard	*rr*	....	....	....	....	....	....
Public Health Service	*ir*	....	....	....	....	....	....
War Department:							
Office of Chief of Engineers	*irc*	*is*	....	*ic*	*ic*	....	....
Board of Engineers for Rivers and Harbors	*is*	....	....	....	....	....	....
Mississippi River Commission	....	....	....	....	*isc*	....	....
Independent Establishments:							
Interstate Commerce Commission	*r*	....	....	....	....	....	....
U. S. Geographic Board	*ir*	....	....	....	....	....	....
Federal Power Commission	....	*ira*	....	....	....	....	....
U. S. Shipping Board	*isrc*	....	....	....	....	....	....
International Joint Commission	*ir*	....	....	....	....	....	....
Inland Waterways Commission	*is*	....	....	....	....	....	....
International Water Commission, United States and Mexico	....	*i*	*i*	....	....	....	....
State Agencies							
New England							
Maine[1]:							
Public Utilities Commission	*s*	*i*	....	....	....	*rs*	....
Inspector of Dams and Reservoirs	....	....	....	....	....	....	*is*
State Board of Health	....	....	....	....	....	*is*	....
New Hampshire:							
Public Service Commission	....	*ira*	....	....	....	....	*ira*
State Board of Health	....	....	....	....	....	*ir*	....
Vermont[2]:							
Public Service Commission	....	*rs*	....	....	*rs*	....	*ira*
State Engineer	....	*i*	....	....	*i*	....	....
State Board of Health	....	....	....	....	....	*ira*	....
Massachusetts[3]:							
Department of Public Utilities	....	*ira*	....	....	....	....	....
Department of Public Works	*isc*	....	....	....	*i*	....	....
State Reclamation Board	....	....	....	*irsc*	....	....	....
Department of Public Health	....	....	....	....	....	*isr*	....
Rhode Island[4]:							
State Conservation Commission	....	*is*	....	....	....	....	....
Public Utilities Commission	....	*ir*	....	....	....	....	....
Board of Purification of Wtrs.	....	....	....	....	....	*ira*	....
Commissioner of Dams and Reservoirs	....	....	....	....	....	....	*ir*
Connecticut[5]:							
Public Utilities Commission	....	*ira*	....	....	....	....	....
State Water Commission	....	....	....	....	....	*ir*	....
State Board of Civil Engineers	....	....	....	....	....	....	*is*
Commissioners of Rivers, Harbors and Bridges	*i*	....	....	....	*i*	....	....
State Board of Health	....	....	....	....	....	*i*	....
Middle Atlantic							
New York[6]:							
Department of Public Works	....	....	....	....	....	....	....
Division of Canals and Waterways	*irc*	....	....	....	....	....	....
Division of Engineering	....	....	....	*is*	....	....	....
Conservation Department:							
Division of Water Power and Control	....	*isrc*	*is*	*isrc*	*ir*	....	*ira*
Department of Health	....	....	....	....	....	*isr*	....
New Jersey[6,7]:							
State Water Policy Commission	*is*	*is*	....	*is*	*is*	....	*ir*
Public Utilities Commission	....	*ir*	....	....	....	....	....
Department of In'ld W'ways	*isrc*	....	....	....	....	....	....
State Board of Health	....	....	....	....	....	*ira*	....
Pennsylvania[6,8]:							
Dep. of Forests and Waters:							
Bureau of Waters	*isrc*	*isr*	....	....	*isrc*	....	....
Water and Power Resources Board	....	*rs*	....	....	*r*	....	*isrc*
Public Service Commission	....	*r*	....	....	....	....	....
East North Central							
Ohio[9]:							
Public Utilities Commission	....	*ira*	....	....	....	....	....
Superintendent of Pub. Works	*irsc*	*irsc*	....	....	*irsc*	....	....
State Geologist	....	*i*	....	....	....	....	....
Indiana[10]:							
Department of Conservation	*s*	*i*	....	*ira*	....	*is*	....
Public Service Commission	....	*ira*	....	....	....	....	....
State Board of Health	....	....	....	....	....	*ira*	....
Illinois[11]:							
Dep. of Purchases and Const.	*irsc*	*ira*	....	*i*	*irsc*	*ira*	....
Board of Water Resource Advisers	*i*	*i*	....	*i*	*i*	*i*	....
Michigan[12]:							
Department of Conservation	....	*i*	....	....	....	....	....
Public Utilities Commission	....	*ira*	....	....	....	....	....
State Advisory Council of Health	....	....	....	....	....	*ira*	....
Wisconsin[13]:							
Railroad Commission	*ira*	*ira*	....	....	....	....	*is*
State Engineer	....	*i*	....	....	*i*	....	....
State Board of Health	....	....	....	....	....	*ira*	....
West North Central							
Minnesota[14]:							
Department of Drainage and Waters	....	....	....	*irsc*	....	....	....

	Nav.	W. P.	Irr.	Dr.	Flds.	Poln.	Dams
Upper Mississippi and St. Croix Riv. Improvement Commission	*i*	....	....	....	....	....	....
State Board of Health	....	....	....	....	....	*ira*	....
Iowa[15]:							
State Board of Conservation	....	....	....	....	*ira*	....	....
Department of Public Docks (City or Town)	*ira*	....	....	....	....	....	....
Board of Railroad Commissioners	....	*ira*	....	....	....	....	....
Geological Survey	....	*i*	....	....	....	....	....
State Board of Health	....	....	....	....	....	*ira*	....
Missouri[16]:							
Public Service Commission	....	*ira*	....	....	....	....	....
Bureau of Geology and Mines	....	*i*	....	....	*i*	....	....
State Board of Health	....	....	....	....	....	....	....
North Dakota[17]:							
State Engineer	....	*ir*	*ir*	....	....	....	....
Board of Water Commissioners	....	*s*	*s*	....	....	....	....
Conservancy District	....	....	....	....	*irsc*	....	....
State Board of Health	....	....	....	....	....	*ira*	....
South Dakota[18]:							
State Engineer	*i*	*ira*	*ira*	*ira*	....	....	*ira*
State Board of Health	....	....	....	....	....	*ira*	....
Nebraska:							
State Railway Commission	....	*r*	*r*	....	....	....	....
Department of Public Works	....	*ira*	*ira*	*ira*	....	....	....
Conservation and Survey Division	....	*i*	....	....	....	....	....
Department of Public Welfare	....	....	....	....	....	*ra*	....
Kansas[19]:							
Public Service Commission	....	*r*	....	....	*ir*	....	....
State Board of Health	....	....	....	....	....	....	....
South Atlantic							
Delaware[20]:							
State and Local Boards of Health	....	....	....	....	....	*ira*	....
Maryland:							
Public Service Commission	*r*	*r*	....	....	....	....	....
State Geological and Economic Survey	....	*i*	....	....	....	....	....
Cumberland Flood Prevention Commission	....	....	....	....	*s*	....	....
State Department of Health	....	....	....	....	....	*ira*	....
District of Columbia[21]:							
Public Service Commission	....	*ira*	....	....	....	....	....
Virginia:							
Conservation and Development Commission	*i*	*i*	*i*	*i*	*ira*	....	....
State Corporation Commission	....	*ra*	....	....	....	....	*ira*
State Board of Health	....	....	....	....	....	*ra*	....
Co-operative Commission on Stream Pollution	....	....	....	....	....	*i*	....
West Virginia[22]:							
Public Service Commission	*ira*	*ira*	....	....	*ira*	....	....
State Board of Health	....	....	....	....	....	*ia*	....
North Carolina:							
Department of Conservation and Development	....	*ira*	....	*ira*	....	....	....
Department of Agriculture	....	....	....	*ir*	....	....	....
State Committee on Stream Sanitation and Conservation	....	....	....	....	....	*is*	....
South Carolina:							
Public Service Commission	....	*ira*	....	....	....	....	....
Land Settlement and Drainage Commission	....	....	....	*i*	....	....	....
State Board of Health	....	....	....	....	....	*is*	....
Georgia[23]:							
Public Service Commission	....	*ira*	....	....	....	....	....
State Geologist	....	*i*	....	*i*	....	....	....
State Board of Health	....	....	....	....	....	*is*	....
Florida[24]:							
State Geologist	....	*i*	....	....	....	....	....
Board of Drainage Commissioners	....	....	....	*irsc*	....	....	....
State Board o Health	....	....	....	....	....	*ir*	....
East South Central							
Kentucky:							
Geological Survey	....	*i*	....	....	....	....	....
State Board of Health	....	....	....	....	....	*ira*	....
Tennessee[25]:							
Railroad and Public Utilities Commission	....	*rs*	....	....	....	....	....
Division of Geology	....	*i*	....	*i*	....	....	....
Department of Public Health	....	....	....	....	....	*is*	....
Alabama:							
Public Service Commission	....	*ira*	....	....	....	....	....
Geological Survey	....	*i*	....	....	....	....	....
State Board of Health	....	....	....	....	....	*ira*	....
Mississippi[26]:							
Geological Survey	....	*i*	....	....	....	....	....
State Board of Health	....	....	....	....	....	*rs*	....
West South Central							
Arkansas[27]:							
Geological Department	....	*i*	....	....	....	....	....
Railroad Commission	....	*ra*	....	....	....	....	....
Bureau of Sanitation	....	....	....	....	....	*ira*	....
Louisiana[28]:							
Board of State Engineers	....	....	....	*irsc*	*irsc*	....	....
State Board of Health	....	....	....	....	....	*ira*	....
Oklahoma:							
Corporation Commission	....	*ira*	....	....	....	....	....
Geological Survey	....	*i*	....	....	....	....	....

	Nav.	W. P.	Irr.	Dr.	Flds.	Poln.	Dams
Commission of Drainage and Irrigation	....	....	*irs*	*irs*	*irs*	....	....
State Board of Health	....	....	....	....	....	*rs*	....
Texas[29]:							
Board of Water Engineers	....	*irs*	*irs*	....	*irs*	....	*is*
State Reclamation Engineer	....	....	....	*irs*	....	....	....
State Board of Health	....	....	....	....	....	*irs*	....
Mountain							
Montana[30]:							
State Engineer	....	*i*	*i*	....	*i*	....	*i*
Public Service Commission Irrigation Commission	....	*irs*	*irs*	....	....	....	....
Corey Land Act Board	....	....	*rsc*	....	....	....	....
State Board of Health	....	....	....	....	....	*irs*	....
Idaho[31]:							
Department of Reclamation	....	*i*	*irsc*	....	*i*	....	*is*
Department of Public Welfare	....	....	....	....	....	*is*	....
Wyoming[32]:							
State Engineer	....	*i*	*i*	....	....	....	*i*
Board of Control—Water	....	*rs*	*rs*	....	....	....	....
State Board of Health	....	....	....	....	....	*irs*	....
Colorado[33]:							
Public Utilities Commission	....	*irs*	....	....	....	....	....
State Engineer	....	*irs*	*irs*	....	....	....	....
Conservancy Districts (County)	....	....	....	....	*irsc*	....	....
State Board of Health	....	....	....	....	....	*is*	....
New Mexico[34]:							
State Engineer	....	*irs*	*irs*	....	....	....	*is*
State Board of Health	....	....	....	....	....	*rs*	....
Arizona:							
State Water Commission	....	*irs*	*irs*	....	....	....	....
State Board of Health	....	....	....	....	....	*rs*	....
Utah[35]:							
State Engineer	....	*irs*	*irs*	....	....	....	*is*
Public Utilities Commission	....	*rs*	....	....	....	....	....
Utah Water Storage Commission	....	*irs*	*irs*	....	*irs*	....	....
State Board of Health	....	....	....	....	....	*r*	....
Nevada[36]:							
State Engineer	....	*irs*	*irs*	....	....	....	....
State Board of Irrigation	....	*irsc*	*irsc*	....	....	....	....
Pacific							
Washington[37]:							
Department of Conservation	....	*irs*	*irs*	....	....	....	*is*
State Geological Survey	....	*i*	*i*	....	....	....	....
Public Service Commission	....	*rs*	....	....	....	....	....
State Board of Health	....	....	....	....	....	*ir*	....
Oregon:							
State Engineer	....	*irs*	*irs*	*irs*	....	....	*irs*
State Reclamation Commission	....	....	*is*	*is*	....	....	....
Commission of Hydro-Electric Power	....	*is*	....	....	....	....	....
Public Service Commission	....	*is*	....	....	....	....	....
State Health Officer	....	....	....	....	....	*is*	....
California[38]:							
Department of Public Works:							
Division of Water Rights	....	*irs*	*irs*	*irs*	*irs*	....	....
Division of Engineering and Irrigation	....	....	*is*	*is*	....	....	....
State Irrigation Board	....	*irsc*	*irsc*	....	....	....	....
Reclamation Board	....	....	....	*irsc*	....	....	....
Department of Public Health	....	....	....	....	....	*rs*	....
Department of Natural Resources Bureau of Hyd.	....	....	....	....	....	*irs*	....

References in the Tables

[1]Maine—*Drainage* under county commissioners, who may appoint committee of three to five with authority to approve, reject, lay out, establish, project and assess damages.

[2]Vermont—*Drainage* under town selectmen; county commissioners may appoint three commissioners to investigate and report. *Flood control:* An advisory commission reported to 1929 legislature.

[3]Massachusetts—*Dam and reservoir* inspection under county commissioners.

[4]Rhode Island—Report on *Water Resources* report made by a commission in 1928.

[5]Connecticut—*Drainage* under county Superior Court, which has authority over construction of drains and levying taxes [collecting cost?]. *Structures* along streams under town selectmen. *Water Resources* reported on in 1928 by State Geological and Natural History Survey.

[6]New York, New Jersey and Pennsylvania—Tri-State Delaware River Commission considering [has drawn] treaty for allocating rights in that stream [which has been ratified by New York only].

[7]New Jersey—*Water Policy Commission* created in 1929.

[8]Pennsylvania—*Water and Power Resources Board* has largely judicial functions and powers.

[9]Ohio—*Pollution* under jurisdiction of sanitary districts [where such have been formed] organized by [under] Court of Common Pleas.

[10]Indiana—*Drainage* commissioners, appointed by county commissioners, may construct works.

[11]Illinois—Department of Purchase and Construction succeeds to powers vested in Canal Commissioners, Rivers and Lakes Commission, Department of Public Works, and Illinois Waterways Commission. *Drainage* and levee districts may be created by county courts with power to construct works.

[12]Michigan—*Navigable waters* under county supervisors, who may maintain levels of rivers and lakes and build dams and embankments. *Drainage* under county drainage commissioners, who can build works.

[13]Wisconsin—*Drainage* under farm drainage boards appointed by county courts, with power to build and maintain works.

[14]Minnesota—*Lake stages* under county boards as regards effect on navigation, public health and welfare. *Power* in cities and villages under 10,000 population under State Water, Light, Power and Building Commission.

[15]Iowa—*Drainage* under county supervisors, who may establish drainage districts to construct ditches and levees.

[16]Missouri—*Pollution* under control of cities.

[17]North Dakota—*Power* and *Dams* under three commissioners appointed by county court. *Drainage* under commissioners appointed by county commissioners. Conservancy district act passed in 1929.

[18]South Dakota—Drainage under county commissioners.

[19]Kansas—*Power Dams* under three commissioners appointed by district judge. *Drainage* under five supervisors elected under authority of county court by landowners of district.

[20]Delaware—Has no laws concerning water resources.

[21]District of Columbia—Deposits of deleterious matter in Potomac River, Rock Creek Park or any tributaries prohibited by Sec. 901, Civil Code.

[22]West Virginia—*Water-power* act effective March 7, 1929.

[23]Georgia—*Drainage* under county court, which may establish drainage districts to locate and construct drains, levees, etc., to reclaim low, wet, swamp and marsh lands.

[24]Florida—Cities and towns have jurisdiction over waters of all rivers, creeks, harbors and bays.

[25]Tennessee—*Drainage* districts with power to build ditches, levees, etc., may be established by county courts.

[26]Mississippi—*Drainage* under three commissioners elected in counties under authority county supervisors; may build ditches, levees, etc.

[27]Arkansas—*Drainage* under county courts, which appoint three commissioners, with authority to build ditches, etc.

[28]Louisiana—*Navigation* districts, with five commissioners, have power to open, widen, deepen and build canals.

[29]Texas—*Navigation* and canal districts, with three commissioners, may improve rivers, canals and bays and construct and maintain canals and waterways.

[30]Montana—Water commissioners, appointed by district court, have power to measure and distribute water and enforce law [what law not stated]. *Dams* inspected by experts appointed by county commissioners.

[31]Idaho—*Drainage* under three district commissioners appointed by district court.

[32]Wyoming—*Drainage* under three district commissioners appointed by district court.

[33]Colorado—*Drainage* under three commissioners appointed by county commissioners or elected.

[34]New Mexico—*Drainage* under three commissioners appointed by county clerk, with power to construct works. *Special commissions* include Rio Grande Survey; also commissioners for distribution of the waters of the Rio Grande and of the Pecos River.

[35]Utah—*Pollution* control by city and town authorities.

[36]Nevada—*Drainage* under county commissioners, who may appoint three supervisors to organize and administer work. *Pollution* under control of cities and counties.

[37]Washington—*Drainage* and diking districts may be organized by county commissioners elected for the purpose. *Pollution* under control of cities and towns.

[38]California—Colorado River Commission has authority over negotiations with [this and six other] states and federal government as to uses of waters of Colorado River. Reclamation board largely concerned with reclamation conditions in Sacramento basin.

New Power Construction on Swedish State System

In order to meet the rapidly increasing demand for power, the Swedish State Board of Waterfalls has a construction program of $2,730,000 for 1930. Of this total, $1,830,000 is for power plants and dams and $900,000 for transmission and distribution lines. The state-owned power stations are divided into two groups: the northern, with Porjus and Norrfors in Lappland, and the central block, consisting of Alvkarleby, Trollhatten, Lilla Edet, Motala and Vesteras. Vesteras is a steam reserve station for the combined central block, while the other stations are water-power plants.

Only minor additions are planned for the northern block. The output of the northern block was 250,000,000 kw.-hr. in 1928. The reserve capacity is sufficient for several years. On the other hand, the reserve in the central block is not great. The total output of this block was 1,315,000,000 kw.-hr. in 1928 and the total capacity is about 1,620,000,000 kw.-hr. The reserve will be utilized in a few years if the demand increases as expected, and two new hydro plants, Vargon and Roxen, and the improvement of Vesteras steam plant are planned for the immediate future. At Vesteras a new unit of 21,000 kw. will be installed, replacing one of the original 7,000-kw. units, together with a new boiler for 22,500 kw. Improvement in steam-turbine practice makes it possible to install the new unit in place of the original unit, now ten years old, with only minor changes in the machine room or pipe system. The plant will shortly be enlarged by the addition of a 50,000-kw. unit, consisting of a 25,000-kw. generator on each end of a Stal steam turbine.

An American Impression of English Roads

Asphalt Emulsions Widely Used to Produce Low-Cost Improved Roads—Various Classes of Local Material Employed to Advantage

By H. L. Bowlby
General Manager, Flintkote Roads Inc.
New York

ALTHOUGH the road problems of the New World are by no means identical with those of Europe, both continents have much to learn from each other. The writer recently completed a tour of inspection of roads in England and the Continent which gave every facility for making a comparison of methods and results in road construction. He was accompanied by eight other road engineers from various parts of the United States and Canada, and the visit was primarily to study the use of asphalt emulsions.

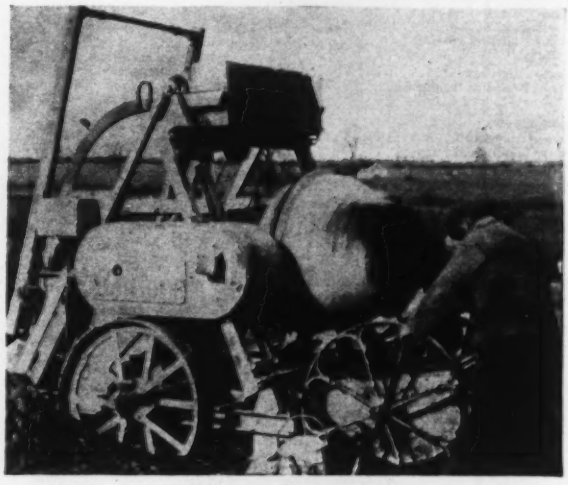
The Highway Research Board, a division of the National Research Council of the United States, recently issued a "Report of Investigation of Low-Cost Improved Roads." The report gives a number of suggestions regarding future research, and particular emphasis is laid upon the development of bituminous emulsions suitable for cold application. Asphalt emulsions have not yet been developed to any extent in America and there is undoubtedly a very great future for their use as a means of providing low-cost improved roads. Consequently the remarkably good work that is being done with them in England and on the Continent was observed by our delegation with considerable interest.

Those of us who had not been in England before were at once struck by the apparently haphazard layout of its road system and then by the good foundations or road bases that have resulted from generations of maintenance with which even the least-traveled roads are generally provided. It was an unusual experience to find the complete absence of earth roads which are necessarily prevalent in America, where less than 25 per cent of the enormous road mileage has as yet been improved beyond the earth road stage. Throughout our entire tour no roads were traversed that could be described as being really uncomfortable to drive over.

Upon arrival at Plymouth we motored by char-a-banc to Liskeard, where the program of road inspection commenced. The main street of the Borough of Liskeard had been resurfaced the day previous by the cold semi-penetration method ("semi-grout," as it is called in England—a better word). This method comprised the spreading of a layer of stone dust upon the old road surface, covering this with a 3-in. course of 2½-in. down to 1½-in. graded granite. Consolidation was assisted by sprinkling with water during rolling, which also had the effect of bringing the stone dust to within about 1 in. of the surface. Asphalt emulsion was applied from pouring-cans at the rate of 1 gal. per square yard; this was covered with ½-in. granite chippings and well rolled. The sealing coat was not to be applied until about two weeks later. The road appeared to be well bound and the simplicity of construction and its low cost are the great advantages of this method.

Proceeding into the St. Austell rural district, four emulsion grouted granite roads that had been built some five years were inspected. In these cases the construction had been carried out at a high cost, as the district required a wearing surface able to withstand the heavy traffic occasioned by the local china clay industry. With these roads 1¾ gal. per square yard had been used for the penetration course, followed by ¼ gal. for the seal coat. The roads had annually received an emulsion dressing at a rate of 5 to 6 sq.yd. to the gallon, and all the work was in first-class condition. A short length of road in this district had been laid with a cold premixed asphalt wearing course.

As the surface or seal coat had not been applied, it was too early to criticise the wearing properties of this form of construction, but the specification is of considerable interest. The stone used was local granite graded from 1½ in. down to dust. The aggregate was mixed in an ordinary concrete mixer at the roadside, the asphaltic binder comprising a special bitumen emulsion added to the mixture in sufficient proportion to form a dense mass upon consolidation. The mixture was taken direct from the mixer, spread, raked and rolled. The whole process was, of course, carried out cold and it is claimed that the work can be undertaken in wet weather without adverse effect.



ORDINARY BATCH CONCRETE MIXER USED IN PREPARATION OF THE COLD MIX

The main street in Crewkerne was of interest, as an inspection of the surface gave the impression that it was an asphaltic concrete pavement presenting an even surface and entirely free of corrugation. Actually, we were informed, the road had been emulsion grouted four years previously, using a 3-in. course of graded granite. Since that time only two surface treatments had been applied and the comparatively heavy main road traffic on this street had had little or no effect upon it.

At the military camp at Bovington a waterbound gravel road was inspected that had been kept up for a number of years by annual surface treatments of cold

ASPHALTIC CONCRETE PAVEMENT NEAR OXFORD
Made of a graded broken stone aggregate and a premixing emulsion binder. A small rotary concrete mixer was used for mixing each batch.

asphalt emulsion. As the road carries fairly heavy military traffic, including tanks and caterpillar tractors, its good condition proved a convincing testimony of the durability of these cold applications. The present condition of the wearing surface is almost perfect.

In the Wareham rural district a 1,000-gal. pressure tank was at work spraying a waterbound macadam surface with emulsion at the rate of 3 sq.yd. to the gallon. The work was being finished with gravel varying in size from $\frac{3}{4}$ in. down to sharp sand, and no rolling was done after treatment. The work of the tank-truck or lorry was particularly interesting in view of the high average rate at which the work was prosecuted. As the refilling of the tank truck from a rail car is the only delay occasioned in the work, the treatment of the surface went forward very quickly and we learned that as much as 7,000 gal. has been applied by one of these lorries with one gang of men in the course of a day.

In the same district some grouting work with flints was being carried out, this being on the Grange-Dulworth Cove road. The road was reshaped and the flints, varying in size from $2\frac{1}{4}$ to $1\frac{1}{2}$ in., were consolidated to a thickness of just over 3 in.; flint gravel, graded from $\frac{3}{4}$ to $\frac{1}{8}$ in., was used as a filler, the whole being well consolidated. Asphalt emulsion was applied at the rate of 1 gal. to the square yard, and subsequently the surface was sealed with $\frac{1}{4}$ gal. and covered with $\frac{3}{4}$ in. to sand gravel and rolled. This section had been down a little over a year and appeared to be in perfect condition. It is understood that this work was carried out at a very low cost, the flint being obtained from local pits.

In Gloucestershire some interesting work was being carried out upon the Northleach-Oxford road, which had given way through lack of foundations and a new base was in the process of construction. Broken slag in large pieces varying in size from 3 in. down to 1 in. was consolidated by rolling to a thickness of approximately 6 in. It was rolled as tightly as possible and $\frac{3}{4}$-in. slag was spread over the surface for a filler. A motor tank truck then grouted this foundation in two applications at a total rate of 2 gal. per square yard. After the first application more $\frac{3}{4}$-in. slag was spread over the surface and rolled, and a further covering of $\frac{1}{2}$-in. slag was applied and rolled after the second coat. It was pointed out that this method of binding foundations had proved very satisfactory. In addition to preventing the admission of water, the method enables the foundations to be used as a wearing surface during the period of settlement, thus enabling a proper wearing surface to be superimposed upon the foundation some months later after the foundation had properly established itself. The work in question was being carried out quite rapidly, from 2,000 to 3,000 gal. of binder being applied daily.

On arriving at Oxford, City Engineer Richardson took us to inspect some work being carried out on the Headington Housing Estate. This work was being done with an aggregate composed of old asphalt pavement which had been taken from some of the Oxford city streets and broken up in a crusher to about 2 in. in size. This material was spread and rolled and grouted with asphalt emulsion in the usual way, making a very durable surface.

Among other roads inspected in Oxford, the Crowmarsh-Goring road was of particular interest. This had been constructed with flints, hand picked from the fields, and grouted with emulsion in 1925. The road had a good surface and its original cost was said to have been very low. On the Eynsham-Stanlake road some semi-grouting work was being carried out upon an old base prior to the laying of an asphaltic concrete. The emulsion in this case was being applied by a spraying and grouting apparatus. The machine comprised a tank fitted upon the back of a roller which was filled from drums by means of a steam suction device. Steam pressure was then admitted to the container, forcing the emulsion through a series of jets onto the road surface.

Before leaving Oxfordshire the Witney-Woodstock road was inspected; this had been constructed some five years before with a very soft friable limestone aggregate. The result was quite satisfactory and would be suitable for the soft limestones of Georgia and Florida.

The work being carried out in the Kettering district was also of particular interest, in that it corresponded to some extent to conditions in the States. In one case an old road had been scarified, reshaped and emulsion grouted, no new stone being added. The work had evidently been done very economically and a good surface had resulted. The other road consisted of a wearing surface of graded slag which had been semi-penetrated with emulsion. As slag is available in certain parts of the

POURING THE FIRST STRIP ALONG THE EDGE OF THE PAVING

States, it was interesting to note the excellent results obtained with slag and an asphalt emulsion.

A large number of roads was inspected in East Anglia, the object of this portion of the tour being to examine as closely as possible the use of gravels and flints with asphalt emulsions. In the Tendring rural district in Essex a 1-in. thickness of clean gravel on a newly waterbound surface was being penetrated with half a gallon of emulsion to the square yard, the work being finished with a heavy sealing coat. The object of this method was to provide a low-cost bituminous wearing course for waterbound roads, and judging from the results obtained, the method can be regarded as successful.

In the St. Faith's rural district near Norwich a small pressure hand sprayer was employed for gravel grouting. The machine helps to give an even covering to the stone, but its operation is somewhat laborious and can no doubt be improved upon.

After returning to London numerous roads were seen in the various metropolitan boroughs. An inexpensive method of treating side streets and light traffic residential streets that has given successful results at low cost comprised the scarifying of the old surface, adding a one-stone thickness of new metal and semi-penetrating with asphalt emulsion. In the East and West Molesey district a road was seen that has been subjected to periodical flooding, in spite of which it had remained in good condition; the road had been semi-penetrated about a year previously. A considerable quantity of emulsion had been used for the treatment of soft wood block pavements and much of this work seemed to be exceptionally good. A number of streets that had been treated twelve months previously showed no trace of the blocks themselves. The surface was even and smooth but not slippery.

A day spent at Aldershot enabled an inspection to be made of various types of military roads. At the Pinehurst barracks, where a battalion of the Royal Tank Corps was quartered, a cold-grouted road had withstood the daily wear of tanks for some five years without showing signs of wear. To show the strain imposed by a fast moving tank the commanding officer kindly arranged for a 30-ton tank to be run at high speed along this road. Although the tank went around a 90 deg. curve at a speed of not less than 20 miles an hour, imposing a very great strain by the thrust of the caterpillar tracks, there was no apparent mark upon the surface. The good wearing properties of this road are undoubtedly largely due to the use of a very good quality granite and to the care that was taken in its construction. A continuation of this road had been constructed across a bog and the stone had been laid upon a raft composed of corrugated iron and flattened emulsion drums. A 3-in. course of stone had been penetrated with emulsion in the usual way, providing a sound surface. Other work in Aldershot comprised emulsion grouted gravel roads, and a number of cement concrete roads which had been efficiently constructed.

COMPLETING A HAND-POURED AREA WITH A SPECIAL POURING CAN

COLD PATCHING BY PENETRATION METHODS WITH AN EMULSION BINDER IN ENGLAND

Small maintenance truck carrying stone chips and the emulsion in drums.

While on the subject of concrete, it may be mentioned that much of the work seen in other districts was not up to our American standards. In some cases the fault was apparently due to improper mixtures and in other cases to faulty laying, and it would appear that an examination of the modern methods of construction in the United States would be of value.

As the object of this tour was to study at first hand the use of asphalt emulsions in England, naturally more was seen of this type of construction than of other methods. We were greatly impressed both by the extent to which road emulsions are used throughout the year and with the good results obtained on roads of nearly all types and usually at economical costs.

Since our return to America we have had opportunity for extensive discussion of this subject of cold asphalt road construction with highway engineers, both state and federal, and find a marked interest in the use of asphaltic emulsions. The general subject of using emulsions has evidently been in their minds for some time, but experimental work under actual field conditions has not been pressed. Now that our British brethren have provided us with so many valuable data we shall undoubtedly witness a material increase in the construction and maintenance of cold asphalt roads and highways.

In conclusion, a tribute should be paid to the extreme kindness shown to our party by the road engineers and public officials whose work was inspected and to the trouble that they took in showing us their roads.

FIG. 1—GENERAL VIEW OF WOODWAY PARK VIADUCT, SEATTLE
Eight 40-ft. spans carried on tall columns without sway bracing of any sort.

High Concrete Stresses Used in Design of Viaduct of Novel Design

Slab Spans of 40 Ft. Have Maximum Depth of 17½ In.—Design Planned for Simple Formwork and Easy Placement

By W. F. Way
Construction Engineer, Henry & McFee, Seattle, Wash.

ILLUSTRATIVE of the advantages and economies in bridge design that result from the use of richer and stronger mixtures of concrete and of proportionately higher working stresses, is the small highway viaduct recently constructed by Snohomish County, Washington, near the city of Edmonds. This viaduct, known as Woodway Park bridge, employed throughout a 1 : 2 : 3 concrete mix, whose strength, for design purposes, was assumed to be 3,000 lb. per sq.in. Based on this assumed strength, working stresses of maximum value recommended by the 1924 Joint Committee report on concrete specifications were used wherever other conditions did not determine the size of members. Stresses of 1,200 lb. per sq.in. in bending and 360 lb. per sq.in. in shear were the limiting values; 16,000 lb. per sq.in. was the working stress in reinforcing steel.

The resulting structure, although of somewhat slender proportions, and having columns 55 ft. high without swaybracing of any sort, was designed with all individual parts of generous size to permit ready and easy concrete placement. The clean simplicity of the long-span one-way deck slabs made the formwork simple and inexpensive. The design closely follows the type of viaduct developed in recent years by the late A. W. Munster, Seattle bridge engineer.

When deterioration of the Woodway Park timber trestle which previously served the highway at this point made necessary a new structure, at first the plan was to rebuild with wood. At the request of near-by property owners, however, it was decided to construct a concrete bridge, if one could be put in within the $25,000 available for the purpose, and the writer was engaged to prepare plans and specifications. A 20-ft. roadway, a 4-ft. sidewalk, standard reiforced-concrete guard rails and 20-ton truck loading were the governing requirements. These were met and the job was completed for a total cost of $24,990, slightly more than $73 per linear foot of the structure. The design and typical details that made possible this low cost are shown in Fig. 2.

Steel forms were used for the columns and capitals. The pouring of the columns for their full height at one operation was accomplished by removing sections of the forms at various heights and filling the successive lifts through these openings.

The cap girders of the two-column bents were made 6 ft. wide, thus reducing the slab span from 40 ft. to 34 ft. clear, on which length the bending stresses are computed. The slab that spans from bent to bent is 16 in. thick at the gutter, 17½ in. thick at the center of the roadway, and deepens an additional 6 in. in a distance of 5 ft. adjacent to the column supports. There were no longitudinal beams. Both concrete and reinforcement were accurately placed. The reinforcing consists of 1½-in. round bars. Where longitudinal bars were used in the top of the slab they were assembled with bars of the bottom layer as shown in section *A-A*, Fig. 2. The thick, heavy slab made possible more thorough and complete curing. This deck is admirably adapted for the distribution of heavy concentrated wheel loads.

Not shown in the drawing nor contemplated in the

design, but used in consequence of the saturated soil conditions which were encountered when the footing excavation was begun, were plain untreated wood pile foundations under each column.

In view of the results previously established by tests with the same cement and aggregate, not many test cylinders were taken on the Woodway Park bridge. The five cylinders that were made averaged, at 60 days, a crushing strength of 4,347 lb. per sq.in.; the highest was 4,573 lb. per sq.in. and the lowest 4,007 lb. per sq.in.

The expansion joint is of the type employed by the late A. W. Munster. Instead of being placed directly over a support it was located close to the dead-load inflection point and the abutting slabs were ended in steel facings; the decreased frictional bearing between the slabs due to this location was carried by machined metal pins rather than by bearing plates. (This type of joint will be described in detail in a later article.) In addition to the expansion joint in the deck, the only other construction joints in the structure were those at the bases and tops of the columns and at the bottom of the hand rail.

Throughout the preparation of the design for this bridge the objective was to get as dense and impermeable a concrete as possible into a structure whose forms had been arranged with a view to the problems of construction. This objective is manifest in the use of 1:2:3 concrete rather than the customary 1:2:4 mix, the studied effort to provide ample clearances so that placement would be made as easy as possible, and the use of reinforcing bars of maximum size in order to obtain wide spacing.

Reasons for Design Features—The following bears on the views which determine the design:

Particularly with long-span slabs, the question of working stresses is of great importance. To adopt a working stress of 650 lb. per sq.in. with a 2,200-lb. concrete but allow only 750 lb. per sq.in. with concrete having a strength of 2,800 lb. or more, as certain standard specifications do, seems to the writer to lack justification. Additional to the lower impact stresses and to the safety against overload which the greater dead weight

FIG. 3—UNDER SIDE OF WOODWAY PARK VIADUCT
Note simplicity of the framing details. Columns are 3 ft. in diameter, with maximum height of 55 ft.

of concrete assures, the tests of Prof. W. A. Slater and R. R. Zipprodt (A.C.I. *Proceedings*, 1920, p. 120) indicate that the strength of concrete in flexure is nearly double its compressive cylinder strength.

The maximum load applied to the Yadkin River arch, with all deck continuity destroyed by completely cutting the deck through in each panel, was apparently the equivalent of four 42-ton trucks, abreast in two lines. Still the arch did not fail. (*Proceedings*, Am.Soc.C.E., March 1929, p. 609.) There appears to be ample justification, although somewhat limited precedent in bridge work, for flexural working stresses 0.40 and 0.45 of the 28-day cylinder strength of concrete.

The three items of loads, impacts, and flexural stress-

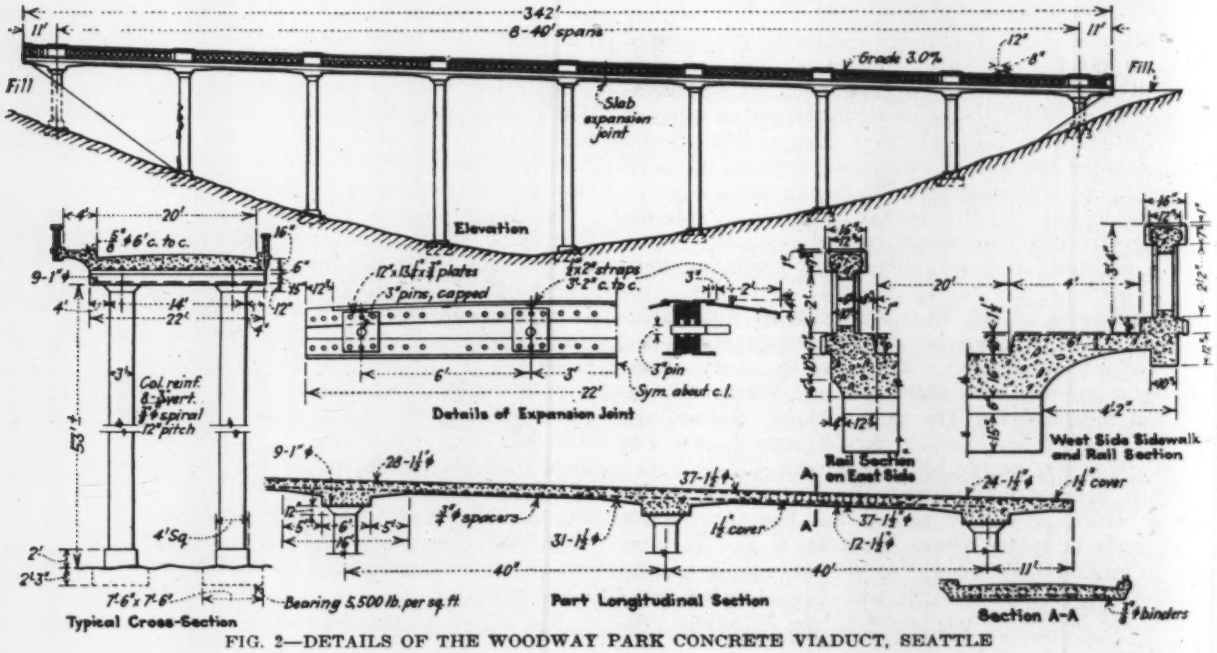


FIG. 2—DETAILS OF THE WOODWAY PARK CONCRETE VIADUCT, SEATTLE

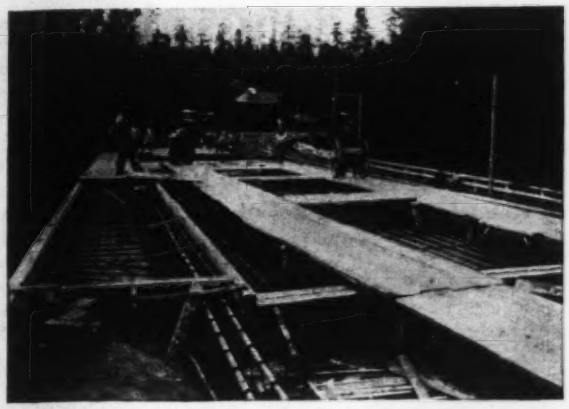


FIG. 4—VIEW OF THE DECK DURING CONSTRUCTION
Expansion joint in the foreground shows one of the pins and the 2-in. steel bonding straps.

es are so intimately connected that to consider the magnitude of the stresses apart from loads and impacts may lead to partial and incorrect conclusions. In other words, whether the assumed working stress be 600 or 1,200 lb. per sq.in., the development of either stress is contingent upon the actual application of loads equal to those assumed in the design. If the applied loads and impacts do not reach their assumed magnitude, then neither will the stresses. Further, the maximum stresses are of very short duration. In this particular bridge the loading assumed was 20-ton trucks, each with 32,000 lb. on the rear axle, passing at midspan, with 100 per cent impact on the rear axle of one truck.

The maximum legal truck load in Washington is 12 tons on four wheels, of which 18,500 lb. may be on the rear axle. Therefore, the 96,000-lb. concentration represented by the assumed loading plus impact is to be compared with a load whose maximum legal limit is 37,000 lb. This means that an allowance of 59,000 lb. of impact for the legally maximum load is contained in the design. Whether this be expressed as 160 per cent of the total load or 320 per cent of one axle load or 640 per cent of one wheel load is immaterial. There further remains to be considered the probability or the improbability of the occurrence of this loading.

The distribution of stresses resulting from continuity of structure always is favorable to economical design with reinforced concrete, and it should be made use of as much as possible. It will be noted that only one expansion joint was used in the Woodway Park bridge. Had the end columns been longer, this expansion joint might possibly have been omitted. The analysis of stress distribution in a continuous structure assumes that the supports will be unyielding. It is true that the stress distribution will be disturbed by settlement of the supports, but this, rather than being a reason for extensive jointing and articulation of structure, appears to be a reason for securing and obtaining unyielding supports. The computations were materially simplified by the use of Hadley's coefficients as outlined in Vol. 93, *Transactions*, Am.Soc.C.E., 1929, p. 1396.

Plans and specifications were prepared by the writer and the work was executed under the supervision and control of Ross D. Alverson, county engineer, Snohomish County, Washington. Hans Pederson was the contractor.

Tendency Toward Smaller Prime-Movers in German Water-Works

DURING the past 25 years the tendency in water-works plants in Germany has been to install an increasing number of pumps of such a type as to require a smaller amount of space than that necessary for triple expansion pumping engines. According to S. Baer, writing in *Engineering Progress* (Berlin) for October, 1929, this trend has been in spite of the advantages of high thermal efficiency and long life possessed by the older types of equipment. There have, however, been some examples of large pumping engines installed during that period, and the most powerful pumping engine for municipal water supply in Germany, and perhaps in the whole of Europe, is the 3,000-hp. engine at Mülheim, which was put into service in 1915 and which has a capacity of 1,584,000 gal. per hour against a static head of 450 ft.

Steam-turbine-driven centrifugal pumps have been installed in increasing numbers, and the smaller amount of space necessary for their housing allows a great reduction in building cost. The turbines operate on steam having pressures as high as 450 lb. per sq.in. and temperatures as high as 720 deg. F. The development in reduction gearing has been such as greatly to reduce the noise, which had formerly been quite troublesome, while the loss of energy does not now exceed 2 or 3 per cent.

Internal combustion engines are coming into use as prime movers for centrifugal pumps, with the greater number of installations up to the present time being of the diesel type. On account of the normal low operating speed of the diesel engine, it is customary to use a step-up gear between the engine and centrifugal pump.

The largest number of the newer installations, however, have been centrifugal pumps driven by electric motors. The disadvantage of the electric drive—that is, its dependence on outside power plants—does not seem to be considered so important a point as it used to be, although this disadvantage not only is one affecting the operation but is also of an economic nature. The enormous expansion in the electric drive is due only partly to the saving of space and attendance offered by it. It is rather its great versatility which induces the water-works engineer to give preference to the electric drive. Electric energy can be remote controlled. The current can be switched off automatically when the water reservoir is filled or when automatic safety devices are actuated. In the case of small plants the energy supply can be restricted to certain hours—for example, the night hours—simplifying supervision of the pumping plant. In addition, if the pumping station is located in a park or in an exclusive neighborhood, there will be no objectionable steam or exhaust gases escaping. In one interesting installation electric motors are used to drive reciprocating pumps. If centrifugal pumps had been installed in this case it would have been necessary to throttle them considerably during their first years of operation, and after careful investigation it was decided to install plunger pumps.

This tendency toward space-saving prime movers has materially assisted the German water-works plants to increase their output as much as 53 per cent when compared with that of fifteen years ago.

Timely Concrete Problems Discussed at Convention

American Concrete Institute, Meeting in New Orleans Feb. 11-13, Presents New Specifications for Concrete for Buildings—Also Considers Industrial Floor Finishes, Cement Variability, Ready-Mixed Concrete and a Research Report on Pavement Curing

Engineering News-Record Staff Report

MEETING far from the center of gravity of its membership, the American Concrete Institute, nevertheless, had a very successful 26th annual convention in New Orleans, Feb. 11-13, 1930. A total of 275 were registered and a majority of these attended each of the five sessions, including two evening sessions. The program was much less crowded than formerly. A smaller number of papers was given at each session, and the program as a whole was broken up by several half-days placed at the members' disposal. On one of these a boat trip on the Mississippi River was enjoyed by about 150 members and guests. The concrete ship "Faith" moored in the river near by was also an object of inspection.

In his presidential address, E. D. Boyer reviewed the development of concrete from the days of backyard mixing to the present scientific age, attributing much of the development to the American Concrete Institute, whose "research efforts have constituted the best possible means of promoting the use of concrete." Mr. Boyer, upon completing two terms as president, pointed to the new committee program as full of promise, and envisioned it as a medium for supplying data to fill in the gaps in our present knowledge. Duff A. Abrams, the newly elected president, was gracefully introduced by A. E. Lindau as a man whose accomplishments have had a world-wide effect on concrete design. "It is an honor for the Institute to have Mr. Abrams for its president as well as an honor for Mr. Abrams to have been elected to this office," said Mr. Lindau. A. R. Lord, consulting engineer, Chicago, was elected vice-president, and Harvey Whipple, Detroit, secretary-treasurer. New directors eelcted were R. B. Young, Toronto; Cloyd M. Chapman, New York City; and Raymond E. Davis, Berkeley, Calif. The 1931 annual convention will be held in Milwaukee, Wis.

Medal Awards

Four members of the Institute were given medal awards for outstanding accomplishments. L. G. Lenhardt, assistant engineer, Department of Water Supply, Detroit, was awarded the Wason medal "for the most meritorious paper presented at the 1929 convention." The paper was entitled "The Concrete Lining of the Detroit Water Tunnels." The Wason research medal was awarded in duplicate to H. F. Gonnerman and P. M. Woodworth, of the Portland Cement Association, for the work reported in their 1929 joint paper, "Tests of Retempered Concrete." The Henry C. Turner gold medal, awarded for notable achievements in or service to the concrete industry, was awarded to Prof. F. E. Turneaure, dean, college of mechanics and engineering, University of Wisconsin, "for distinguished service in formulating sound principles of reinforced-concrete design."

In addition to committee reports and research results, five papers of general interest were presented—"Concreting Methods at Chute a Caron Dam in Quebec," by I. E. Burks, concrete technician for the Alcoa Power Co.; "Design and Construction of Bonnet Carré Spillway," by Capt. Helmer Swenholt, Corps of Engineers, U.S.A.; "Making and Placing Concrete Revetment Mat," by Lieut. Morris W. Gilland, Corps of Engineers, U.S.A.; "Cementing Oil Wells," by J. E. Hough, Portland Cement Association; and "Design of Gulf Shore Protection Structures," by J. B. Converse, consulting engineer, Mobile, Ala. The subject matter in the first four of these papers has been presented in previous issues of *Engineering News-Record* as follows: Chute a Caron Dam, Oct. 24, 1929, p. 641, and Dec. 5, 1929, p. 889; Bonnet Carré Spillway, Aug. 15, 1929, p. 242; Concrete Revetment Mat, Jan. 31, 1929, p. 182; and Cementing Oil Wells, March 8, 1928, p. 392.

New Concrete Building Specifications

The first two of a contemplated new series of specifications to be issued by the American Concrete Institute were presented at the convention. These were companion specifications "for concrete work on ordinary buildings" and for "fabricating and setting reinforcing steel." The specifications were prepared by Arthur R. Lord and William F. Zabriskie, author-chairmen of the respective committees.

The specification for concrete work on ordinary buildings contains several innovations, although the recommended practices are used widely in securing good concrete. For instance, the determination of concrete strength from preliminary tests on a water-cement ratio basis has not appeared before in a general specification. There are also two "material dealer" provisions, planned to insure better and more uniform concrete ingredients. These are (1) the requirement that cement be held in sealed storage until seven-day tests have been completed, and (2) the requirement that a constant source of supply for all material be maintained on each job. The latter is stressed as one of the vital provisions of the specification. Admixtures to be admitted under this classification must be "thoroughly tested by reputable independent investigators." All special cements must undergo the same investigation.

Another provision is that "concrete shall not be dropped through reinforcing steel so as to cause separation of the coarse aggregate from the mortar on account of repeatedly hitting rods as it falls." Hoppers or vertical ducts must be used. Seven-day curing is also demanded by this specification, and if special watertightness is required, the curing period is placed at 21 days. Also, all portions of the structure must be kept moist and warm for the whole curing period.

The reinforcing steel specification is presented as a fair and adequate compromise between field expediencies and design necessities. As a supplement to this specifi-

cation Mr. Zabriskie, the author-chairman, also prepared a "Steel Setters' Primer"—a discussion in non-technical language of the importance of the reinforcing steel and of the theory of its position.

Ready-Mixed Concrete

The subject of ready-mixed concrete was perhaps the most actively discussed of any presented at the convention. Consideration of the subject began with the presentation of a progress report by Miles N. Clair, of the Thompson & Lichtner Co., Boston, Mass., author-chairman of the committee on "Specifications for Centrally Mixed Concrete." Ready-mixed concrete as covered by the proposed specification includes both central-plant mixed concrete and central-plant proportioned truck-mixed concrete. Important provisions are that the operation of all central plants shall be under the direct supervision of a competent testing engineer; that each load of concrete shall be accompanied by a certified statement of the quantity of all the ingredients used and the quality of the concrete delivered; that at least one specimen be tested for each 50 cu.yd. of concrete placed. Also it is stipulated that for central-plant mixed concrete, ordinary flat-bottom trucks shall not be used to transport concrete whose consistency is wetter than a 2½-in. slump. For wet concrete, agitator bodies are required. Furthermore, central-plant mixed concrete shall not be transported in any case for a period in excess of one hour after the addition of the cement. For central-plant proportioned truck-mixed concrete, the following provisions are stipulated:

1. If the aggregate and cement are introduced into the transporting and mixing vehicle together, the procedure shall be such that they are uniformly distributed throughout the batch.
2. Vehicles used for transporting and mixing shall be so constructed as to insure rapid delivery and proper mixing without segregation or loss of the ingredients.
3. When the aggregate and cement are batched together, they shall not be transported in any case for a period in excess of one hour after the addition of the cement to the aggregate.
4. Means shall be provided so that the quantity of water added to the mix can be readily checked.

In discussing this specification, R. S. Freeman, consulting engineer, of Albany, felt that it required too much certification from plants that were able to produce good concrete and necessarily did produce it because they depend for their existence upon the quality of product delivered. H. F. Thompson, central plant operator of St. Louis, stated that central mixing plants produce much better concrete than 1:2:4 (which is usually specified) and suggested, therefore, the use of a strength specification, which would prove beneficial for both user and plant operator. He also suggested the possibility of basing such a strength specification on workability rather than on the water-cement ratio. W. E. Hart emphasized the necessity for a satisfactory specification at the earliest possible moment, pointing out that there are now about 150 commercial central mixing plants as compared to about a dozen two years ago.

Another committee report on the program, Frank I. Ginsberg, author-chairman, considered the subject of Design and Operation of Central Mixing Plants. Discussion of this subject brought out that the cost is about the same whether agitator or truck-mixer outfits are purchased. In the opinion of one discusser, truck-mixers are more satisfactory, and the criticism that the mixing cannot be controlled may be met by the use of some sort of a tachometer to record the number of revolutions of the drum. H. F. Thompson, of St. Louis, favors the central mixing plant supplemented by non-agitator bodies for dry mixes (2½-in. slump or less) and agitator bodies for the water mixers. Another central-plant operator spoke of the necessity for compartment bins because of the demand for different types of aggregates. He also favored the use of bulk cement and of 1-yd. or 3-yd. trucks, a 2-yd. truck being uneconomical for either large or small orders. The 3-yd. mixer was held by several to be the most economical.

Curing Concrete Pavements

A paper by H. F. Gonnerman, manager, research laboratory, Portland Cement Association, described a laboratory investigation of the relative effect on compressive and flextural strengths, wear and surface hardness of concrete by several of the methods recently advocated for curing concrete roads. Specimens consisted of 6x12-in. cylinders, 7x7x38-in. beams and 8x8x5-in. blocks. Seventeen methods of curing, grouped into four general classes—water curing, surface coating, calcium chloride admixture, and calcium chloride surface covering —were utilized.

The principal conclusions from the tests were as follows:

1. There were marked differences in the strength of similar specimens cured in the same manner but tested wet on the one hand and "as cured"—that is, dry or semi-dry—on the other.

Cylinders tested wet always showed lower strength than when tested "as cured." In contrast to the cylinders, beams tested wet were generally stronger than those tested "as cured." Compressive strengths are given more weight because the cylinders were more thoroughly saturated than the beams after soaking in water for the periods used.

2. Cylinders cured by the various methods showed only minor differences in compression strength at ages of one to seven days, most of them having strengths equal to or greater than water-cured cylinders at these ages. However, after three months and one year none gave strengths equal to continued water curing.

Cylinders cured in Sisalkraft bags or by means of Tarvia, McEverlast paint, Curcrete, linseed oil and paraffin had approximately the same strength at the different ages as cylinders cured in a moist room for thirteen days. Compression strengths for these methods ranged from 75 to 85 per cent at three months and from 58 to 76 per cent at one year of the strength of cylinders cured in water.

The results indicated that the coating of sodium silicate was of little or no value as a means of curing concrete, also that the admixture of calcium chloride (2 per cent by weight of cement), while increasing the strength, was not a satisfactory substitute for a few days of moist curing.

3. Air-cured concrete with and without admixture of calcium chloride, concrete cured in a moisture room for two days and concrete cured with sodium silicate had relatively low resistance to wear, while concrete cured by the other methods had approximately the same resistance to wear as concrete cured moist for thirteen days.

4. In general, the specimens showing greatest losses of moisture at time of test had lowest strengths. Those treated with bituminous, linseed oil and paraffin coatings and those incased in Sisalkraft paper lost water gradually but greatly retarded rate compared with air cured and sodium silicate coated specimens.

5. Lowest absorptions were shown for the curing methods which developed greatest strength and resistance to wear.

In the discussion it was pointed out that a similar study, but under field conditions, involving 25 different types of curing is being carried out by the Tennessee state highway department and will soon be published by the Bureau of Public Roads. According to Lieut.-Commander Morrell, recent Navy Department tests show that the effectiveness of curing methods depends more upon climatic conditions at the time of test than upon anything else. In his opinion calcium chloride should never be considered as a curing agent, but as an accelerator. Bituminous coatings absorb heat and it is therefore reasonable to expect, in Lieut.-Commander Morrell's opinion, that concretes cured with them may be called upon to resist high temperature stresses before they have properly set. This is especially true in climates with

wide temperature variations. He also pointed out that in a hot climate straw and earth provide an insulating blanket and result in the best possible curing.

Winter Concreting

In a committee report on winter concreting methods, by Robert C. Johnson, Immel Construction Co., Fond du Lac, Wis., author-chairman, the importance of proper curing was given further emphasis. This report recommended that concrete should be kept wet for seven days after it has been placed. A similar recommendation is to be found in the new specification for concrete for ordinary buildings mentioned above. Concrete can be kept moist by frequent sprinkling in hot weather and by the use of escaping steam or water near salamanders in cold weather. Concrete that has become frozen can be thawed out slowly and kept warm and wet for at least twenty days, but should never be allowed to freeze and thaw alternately. According to R. B. Young, of Toronto, who read the paper, any freezing of concrete permanently damages it, by leaving air holes when the water evaporates. Other recommendations in the report are that concrete should be placed in the forms not colder than 70 deg. F. and not hotter than 140 deg. F. Sand and stone should be heated when air temperature drops to about 35 deg. The report describes methods of heating materials and of protecting the concrete. Mr. Johnson pointed out that the length of the heating and protecting period may be materially reduced by the use of early strength cement, by increasing the cement content or by decreasing the water-cement ratio.

In discussion some differences of opinion developed as to the maximum temperature to which concrete should be heated because of the danger of flash set. Values ranging from 120 to 180 deg. were suggested as being dangerously high temperatures. Probably the lower values are safer, particularly when cement is placed in large masses subjecting it to considerable additional heat during setting. R. B. Young suggested that the maximum might better be set at 100 deg., and more money spent for protection.

That concrete can be placed at almost any temperature was shown by the paper presented at an earlier session describing construction methods at the Chute a Caron dam in northern Quebec, where concrete has been placed at temperatures as low as —50 deg. F. Advantageous factors contributing to pouring in this cold climate are the placing of the concrete in large masses and the use of an unusually dry mix requiring electric tampers to insure consolidation.

Variations in Portland Cement

A report on "Variations in Standard Portland Cements" by P. H. Bates, of the Bureau of Standards, pointed out that in most studies of concrete, cement has not been considered to be one of the variables. The report emphasized the lack and also the need of data on this very important subject. Mr. Bates presented in his report data reported in 1928 by committee C-1 of the A.S.T.M. showing strength tests of 32 brands of cement in which the seven-day test values ranged from as low as 230 lb. per sq.in. to as high as 350 lb. per sq.in. The tabular data from these tests showed that the cements now on the market vary considerably in strength whether tested at early or late stages, either as mortar briquets or as concrete cylinders; also that briquet strength is not indicative of the strength which the cement may develop in a concrete. Another point brought out by Mr. Bates was that no method of measuring workability is yet available, but that the device needed must be such that "there will be measured the ratio between flow and the pressure causing the flow, especially at different rates of flow."

In discussion it was cited that the Kansas highway department recently completed a study of fifteen cements, with results similar to those reported by committee C-1 of the A.S.T.M.—that is, showing wide variations, with average 28-day strengths of 400 lb. and seven-day strengths of 300 lb. It was also pointed out that the Tennessee highway department is making studies of different brands of cement with varying water-cement and sand-cement ratios. In written discussion Thaddeus Merriman suggested a remedy for the present uncertain situation as to cement quality, by writing a specification for portland cement that would relate the strength it develops to its content of lime. At present many underburned cements pass a specification for strength that would not pass one for "completeness of manufacture." Mr. Merriman also presented data to show the wide variations in the portland cements reported by committee C-1 when measured by the solubility of 10 gr. of each in 100 c.c. of 15 per cent sugar solution. Solubilities ranged from 3.9 to 44.7.

Industrial Floor Finish

A report on "Good Practice in Concrete Floor Finish Construction" was made by John G. Ahlers, author-chairman, who presented with it specifications for both heavy- and light-duty floor finishes and for dusted-on floor finish. The report was also accompanied by a description of the proper methods of manufacturing floor finishes as brought out in a recent investigation by W. E. Hart, of the Portland Cement Association, in which he made several test floors comparing a finish of 1:2 mortar and one of 1:1:2 pea gravel. The latter type of floor has also recently been used by Mr. Ahlers in an industrial building in New York City with a unit cost, including all material and labor, of approximately 7 cents.

The committee report stated that inferior floors are caused by:

Use of too much mixing water.
Too much manipulation (screeding, floating, troweling) of the wet mix, bringing fine particles and laitance to the surface.
Too high percentage of fine particles (passing the 50 mesh) in the sand.
Improper curing.

On the other hand good floors can be produced by:

Limiting the mixing water to from 4½ to 5 gal. per sack of cement and increasing workability by longer mixing.
Using only coarse sand.
Using not less than 1½ parts of coarse aggregate.
Not floating or troweling the surface when it is wet and sloppy.
Delaying the finishing operation after screeding until all surface water has disappeared (from 30 to 45 minutes).
Curing for not less than seven days.

In the accompanying illustration a comparison is shown between an ordinary 1:2 mortar finish and one composed of one bag of cement, 1 cu.ft. of sand and 2 cu.ft. of pea gravel or crushed stone, ⅛ to ¼ in. in size. Five gallons of mixing water was used per sack of cement.

In presenting slides showing this floor, Mr. Hart stressed the fact that improper manipulation is one of the chief causes of poor concrete floors. They are often worked and troweled to such an extent that a surface of non-wearable mortar is brought to the top. One of the important stipulations with regard to the pea gravel floor is that it shall merely be screeded off, no troweling or floating being done. Also, about 45 minutes should be allowed to elapse before the base is brushed thor-

oughly to give a good bond for the pea gravel topping, which should then be applied immediately.

A paper by J. B. Converse, consulting engineer, Mobile, Ala., described the design of Gulf shore protection structures, emphasizing the necessity for mixes of high cement content—that is, from seven to ten bags—and a water content of about 5½ gal. Two other papers presented were "Economics of Tall Building Design," by R. R. Zipprodt, a lengthy generalization on the subject, and "Deflections of Reinforced-Concrete Members," by T. D. Mylrea, which was read by title only.

Reinforced-Concrete Column Tests

The reinforced-concrete column investigation, for which the American Concrete Institute is raising about $35,000 and which is now under way at the University of Illinois and at Lehigh University, was described by Prof. W. A. Slater, of the latter institution. Prof. Slater pointed out that there were 573 columns on the test program and that by a coincidence a total of 572 column specimens have previously been tested in this country and Canada, according to the committee's compilations. Particular emphasis in the tests is to be placed on the action of the longitudinal reinforcing steel. Separate tests are designed to study the effect of lateral reinforcing. The majority of the specimens will be 8 in. in diameter and 5 ft. long, although a few will be 28 in. in diameter with spiral reinforcing and with a length of 7½ times the diameter.

It is planned to determine from the first few tests whether square ends or capitals should be used. It is hoped to find out how and when the concrete load is transferred to the steel, if it is, thus adding to the information available on the subject of the yielding of concrete, commonly called flow. The preliminary tests have been made at Illinois and will soon be under way at Lehigh.

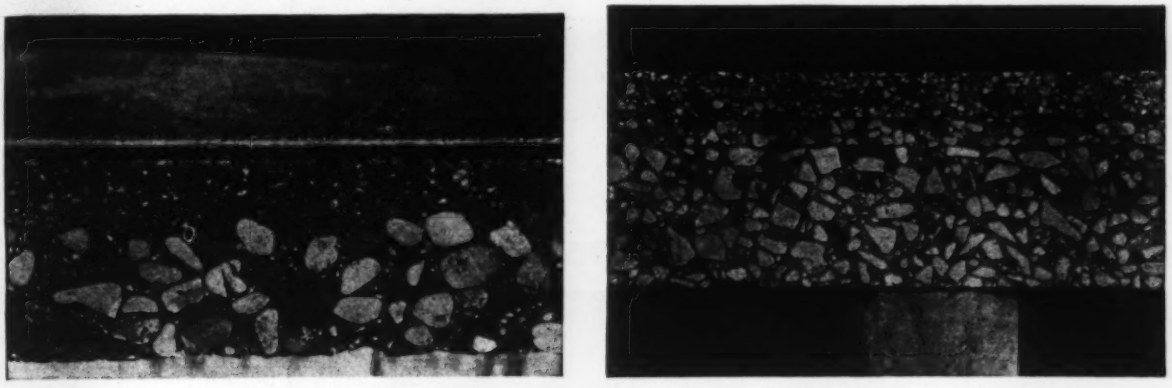
Concrete Products

As is customary, one session was devoted to papers on concrete products. A paper on "Some Tests of Concrete Masonry Units Cured With High-Pressure Steam" reported as a conclusion that high-pressure steam curing has possibilities as a means for developing concrete products having high early strength and low shrinkage, when laid up in masonry walls.

A paper entitled "A Study of Volume Changes in Concrete Masonry Walls," by W. D. M. Allan, manager cement products bureau, Portland Cement Association, reported a series of wall panel tests. Aggregates were sand-gravel, haydite and cinders, and shrinkage was greatest in the cinder units and least in the sand-gravel blocks. The tests showed that air drying reduces shrinkage from 25 to 35 per cent of that in saturated units, a fact of importance in building construction. A 26-day period of air curing gave a minimum amount of shrinkage. Another conclusion from these tests is that it is important to remove the last 2 to 5 per cent of moisture from the blocks before they are used.

In discussion following this paper, Prof. R. E. Davis, of the University of California, remarked on the importance of a knowledge of total volume change, that is—both expansion and shrinkage—citing an instance where a masonry block curtain wall had expanded upward against a concrete spandrel beam, stressing the reinforcing steel beyond its yield point. P. H. Bates mentioned the use of occasional joints of plastic mortar in terra cotta facing, and remarked on the probable necessity of their use in concrete block walls to take care of this expansion.

In a committee report on Recommended Manufacturing Practice for Block and Building Tile by P. M. Woodworth, author-chairman, it was emphasized that the increase in the use of concrete masonry units for back-up, inclosure and partition walls has caused curing to assume added importance.



FLOATED 1:2 MORTAR FINISH COMPARED WITH A 1:1:2 SCREEDED PEA GRAVEL FINISH

A committee report on Recommended Practice for the Use of Cast Stone by L. A. Falco, author-chairman, emphasized the need for a satisfactory absorption test for this type of concrete unit. Another committee report by Benjamin Wilk, author-chairman, entitled "Plant Design for Single or Multiple Shift Operation," evaluated the different factors favorable to each, and concluded that a single shift was the most satisfactory and economical. Disadvantages of using night shifts are: (1) payment of bonus for night work; (2) increased breakage; (3) increased number of accidents to workman; (4) need for additional supervision.

"Color in Concrete Products" was the title of a committee report by Raymond Wilson, author-chairman of the committee. Three coloring methods are available: (1) colored pigments; (2) surface treatment or penetration method; (3) colored aggregate. Iron and chromium oxide and manganese dioxide are commonly used in pigments and are added in an amount of 10 per cent by weight of the cement. It is ordinarily best to premix the cement and color. In using colored aggregate, good effects are secured by using considerable fines and by leaving gaps in the grading. Difficulties have been experienced with penetration methods, and surface coating has not generally proved successful.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Metcalf and Eddy Textbook Revised

SEWERAGE AND SEWAGE DISPOSAL: A Textbook—By Leonard Metcalf and Harrison P. Eddy. Second Edition, Revised by Harrison P. Eddy. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9¼ in.; pp. 783; 224 illustrations. $6.

REVIEWED BY PROF. JOHN GREGORY
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In 1914-15 there appeared the well-known three-volume treatise "American Sewerage Practice," written by Metcalf and Eddy, and in 1922, in response to repeated urging, the same authors brought out a one-volume textbook entitled "Sewerage and Sewage Disposal." This textbook was, in effect, an abridgement or condensation of the three-volume edition, and was prepared primarily for use in engineering schools. And now, eight years later, a second edition of this textbook appears. The writer reviewed the three-volume edition, and it is a pleasure now to review the second edition of the textbook.

One of the authors, Mr. Metcalf, died in January, 1926, and, as was the case with the second edition of Vol. I of "American Sewerage Practice, Design of Sewers," the responsibility for the second edition of the textbook has fallen on the surviving author, Mr. Eddy. To make the book better suited for teaching, the author enlisted the assistance of Prof. Richard G. Tyler, of the Massachusetts Institute of Technology, and of Prof. Gordon M. Fair, of Harvard University, and, as stated in the preface, they had much to do with putting the book in the shape in which it now appears. Mr. Eddy gratefully acknowledges his indebtedness to them, and acknowledgment is also made of the important help of some of Mr. Eddy's partners and staff, especially to Messrs. Sherman, Raymond, Houser and Taylor. The book, therefore, may be said to represent, to an unusual degree, the combined views of experienced engineers and of those experienced in teaching sanitary engineering.

The book has been almost entirely rewritten and has been expanded in size from 598 to 783 pp. The arrangement of the material has been considerably changed, especially in that portion of the book devoted to sewage disposal, and is more logical and better adapted to class-room work. Another feature, which is notable, is the great increase in the number of problems, there having been only twelve in the first edition, whereas there are 144 in the second. The addition of this large number of problems should be greatly appreciated by those engaged in teaching sanitary engineering. Answers are given to such of the problems as can have numerical answers.

Again, at the end of each chapter dealing with some phase of sewage disposal, references to engineering literature bearing on the matter treated are given, there being a total of 60 such references. The writer is especially glad to note that the date of publication is given uniformly with each reference. Such dates are of great value to the user of the book, whether he be a student, an instructor or a practicing engineer. It is not clear, however, why similar references in the chapters dealing with sewerage have been omitted. References could well be added to those chapters.

Following the 32-p. introduction, there are 311 pp. on quantity of sewage and stormwater, design and construction of sewers, and 376 pp. on quality of sewage and various means of disposal. In the closing chapter, Financial Considerations, there are 24 pp.

In the last eight years, since the appearance of the first edition, there has been relatively a much greater advance in the art of sewage treatment than in the design and construction of sewers, and the reader will find the latest methods of sewage treatment and sludge digestion well presented.

The book is an excellent one and stands in the first rank of those dealing with sewerage and sewage disposal. Notwithstanding that the book has been prepared primarily as a textbook, the practicing sanitary engineer and sewage-works operator will find it a welcome addition to his library. The cuts and drawings are well executed and the book is well printed and bound. A very commendable feature is the very extensive index, 39 pp. Of the 224 illustrations, only fourteen are halftones. While illustrations take space, nevertheless more halftones could well be added, especially those illustrating the treatment of sewage. They materially assist the student in grasping the subject. And again, even at the expense of space, a list of the illustrations and cuts as well as a list of the tables would still further improve the value of the book. Such lists, to the student as well as to the practicing engineer, are often of great assistance and convenience.

French and American Visions

THE CITY OF TOMORROW and Its Planning—By Le Corbusier, translated from the 8th French Edition of Urbanisme, with an introduction by Frederick Etchells. New York: Payson & Clarke, Ltd. Cloth; 7½x10 in.; pp. 301; line cuts and halftones. $7.50.

THE METROPOLIS OF TOMORROW—By Hugh Ferriss. New York: Ives Washburn. Cloth; 9x12 in.; pp. 140; illustrated. $7.50.

For a French architect to propose that the city of tomorrow should be composed almost wholly of skyscrapers is not what one would expect. It is even more surprising to have from such a source a proposal that mass production should be carried to its limit in the construction of both business and residence structures, including even the furnishings of the latter. One would like to know whether Mr. Ferris was aware of Le Corbusier's conception when The Metropolis of Tomorrow was written. We do not mean to imply plagiarism, for despite the similarity of the two books in title and in that each proposes systematically spaced skyscrapers, Mr. Ferris' conception is a logical outgrowth of his pictorial work for various architects of recent American tall buildings.

Le Corbusier introduces his conception of the city of tomorrow by an able and interesting essay on architecture and city planning in which he claims that the right line and right angle should predominate in both. He outlines a plan for a city of 3,000,000 pe[illegible] business concentrated in 24 centrally located and equally spaced tall buildings, cruciform in plan from top to bottom except for what may be termed bay windows.

Residences would be composed of huge twelve-story blocks, following two types of floor plan, uniform in their outer line from top to bottom, one with re-entrant right angles, the other quadrangular, and each with "hanging gardens" (a large space open to the air on one side) for each two-story family unit. The business buildings would occupy only 5 per cent of the ground space and the residence blocks considerably more. Nearly all the remainder would be open space, largely given up to parks and gardens. Streets would be wide and far apart, greatly reducing the number of street intersections. In the center of the business district there would be a huge transport station, with a landing space for air taxis one story above the street level, and trunk-line railways, interurban and urban stations on lower level. There would be garages for offices and residences, roof gardens, an industrial section, an outer protected (parked) zone and farther away an airport and garden cities.

Mr. Ferris divides his book into three parts. The first one makes use, for the most part, of perspective sketches of various recent tall buildings of the setback type to illustrate how American architects have met zoning restrictions as to percentage of lots built upon and have gradually worked out a type of architecture to utilize setbacks effectively. In Part II the author passes from specific buildings to "projected trends," dealing mostly with setback problems and suiting their solution to buildings of different classes. The third part, An Imaginary Metropolis, includes sketches and explanatory text to illustrate a city having more or less regularly spaced tall buildings of the setback type, grouped and differentiated in outline according to the classes of use—business, art, science, power, finance, technology, industrial arts, religion, philosophy. Some of the buildings might cover two or more blocks for a few stories above the base, with a huge tower at the center. Between the large and tall buildings, structures six stories high, or less on narrow streets, are assumed. The conception is one of open spaces between the skyscraper portion of the buildings only, in contrast with Le Corbusier's design for immense open ground spaces.

It will be seen that the Frenchman sets up a thesis for an ideal city and works out plans accordingly, while the American first traces the evolution of our towering buildings with setbacks, then proposes to space them so as to give air and light above the roofs of what may be called ordinary buildings. The American gives scarcely any attention to movement of population. The Frenchman has that constantly in view—in fact, the almost unbearable traffic congestion in Paris and other large cities is one of the things that has concentrated his attention on the need for a revolution in city planning, which he thinks should go so far as the rebuilding of portions of Paris.

Two objections to Le Corbusier's conception of tomorrow's cities that will arise in most minds are cost and appearance, both of which he has foreseen and met to his own satisfaction. He gives practically no consideration to the obstacles in the way of taking private property for so revolutionary a plan.

Both books deserve wide reading: Le Corbusier's because of its boldness and thoroughness of analysis of one of the greatest problems of this perplexing century; Ferris because it keeps close to what is already being done with tall buildings in America and because it projects current achievements into the metropolis of tomorrow.

German Treatise on Hydraulic Engineering

DER WASSERBAU: Ein Handbuch für Studium und Praxis—Von. Ing.-Dr. Tech. Armin Schoklitsch, Ord. Professor des Wasserbaues an der Deutschen Technischen Hochschule in Brunn. Ester band. Vienna: Julius Springer. Cloth; 8x11 in.; pp. 484; 708 illustrations. 52 marks.

The first part of Dr. Schoklitsch's two-volume treatise on hydraulic engineering consists of six chapters. The first four chapters are really specialized treatments of more general subjects, and are entitled Meteorology, Fluid Phenomena and Hydraulics, Soil Phenomena, and Building Materials for Hydraulic Structures. These chapters are of special interest to American engineers in that they treat subjects not usually included in our books. For instance, the chapter on hydraulics treats of the action of suspended material in flowing rivers, ice phenomena and groundwater flow. The chapter on soil phenomena is especially complete. The last two chapters are devoted to water supply and sewerage. The former includes discussions of service requirements, purification processes, sources of supply, water storage and water distribution. Under sewerage both collection and treatment of sewage are considered. As is usual in current German technical books, typography and illustrations are admirable, and while the binding is somber, it is sound and serviceable.

The second volume, it is promised, will deal with dams and impounding reservoirs, hydraulic power plants, drainage improvements, river structures and water transportation.

What Chicago Is and Why

CHICAGO: A More Intimate View of Urban Politics—By Charles Edward Merriam, Professor of Political Science in the University of Chicago. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 305. $3.50.

Seldom is a book dealing with the local political aspects of a great city so opportune as this one telling what Chicago is and why. It falls short of absolute timeliness only by the period that must elapse between the writing and publication of so comprehensive a book. Had the book been completed a little later its dramatic effect, already striking, would have been heightened. The author would then have pictured one of the largest and wealthiest cities of the world, abounding with leaders in finance, commerce, industry and the professions, in a financial plight unparalleled in history; a city with a treasury so empty month after month as to be unable to pay the salaries of its thousands of employees. But had the book been delayed long enough to bring this feature into the picture, it would have merely intensified without materially altering Professor Merriam's brilliant exposition of why Chicago and its politics are as they are at the present time.

The opening sentence of the book, with its implications, goes far toward explaining the past and present political status of Chicago: "A city of 4,000,000 with a history of less than a hundred years is seldom found in the annals of municipalities." Rapid growth in population epitomizes the whole story. The many details, outlined in 300 tellingly written pages, may be summarized in five words: a host of contending interests. Without regard to order of importance, these include race, religions, social and economic status, political creeds and moral codes. Sometimes one and sometimes another of these interests, played upon by chance or by the cunning of politicians, turns the scale for good or poor government in Chicago.

In his analysis the author emphasizes the lack of

continuous support of good government by business and professional men because they conceive their interests lie the other way. Engineers, as well as bankers and contractors, are put in this category in the author's estimation.

In one respect Chicago is handicapped more heavily than any other great metropolitan area; it suffers from a multiplicity of overlapping governments. There are six or eight independent tax-levying bodies in Chicago itself, scores in Cook County and many hundred in the Chicago region. In another respect also Chicago is worse off than many large cities: domination by the state legislature.

Aside from these two respects, and rapid growth in population and wealth, the author puts little emphasis upon Chicago being politically different, or at least worse off, than other cities. Not that he fails to make comparisons that show differences; but again and again he says, in effect, that New York or Philadelphia are in as bad a way as is Chicago. There is at least sufficient truth in this to make the book of broad appeal throughout the country—in small cities as well as large, for in many of these things cities vary only in scale. This breadth of appeal, the compelling way in which the book is written, and the fact that the author has himself taken a large practical part in the government and politics of Chicago, besides being a deep student of government and politics for many years, combine to make his book a notable contribution to the literature of municipal government.

German Discussions of Water and Sewage

REVIEWED BY WILLEM RUDOLFS

Chief, Department of Sewage Disposal, New Jersey Agricultural Experiment Station, New Brunswick, N. J.

VOM WASSER—Ein Jahrbuch für Wasserchemie und Wasserreinigungstechnik. Herausgegeben von der Fachgruppe für Wasserchemie des Vereins Deutscher Chemiker. III Band, 1929. Berlin: Chemie, G.m.b.H., Berlin W 10. Paper; 7x10 in.; pp. 282; illustrated. 20 marks in paper or 21 bound.

The third volume of the yearbook Vom Wasser contains the papers (with discussions) given before the annual convention of the German water chemists and water engineers held at Breslau in May, 1929. In the field of water purification several papers are of interest. Among these Eggers describes studies on the flow of water through filters traced with fluorescein, Engler the purification of surface waters containing humic acids, Pick gives results on dechlorination with active carbon, Olszewski discusses disinfection with silver salts and Katadyn silvers, Czensny gives an improved method of pH determinations, and Austin discusses the permanganate and chlorine consumption in water containing large quantities of iron. A long and interesting paper by Professor Bruns treats of the relation between water-borne epidemics and water purification.

Under sewage disposal, the Breslau plant is described by Weber, sludge digestion is discussed by Heillmann (Halle) and sewage chlorination by Viehl. Bach gives a review of the present and probable future tendencies in water purification and sewage treatment and a résumé of improvement in chemical analyses of water purification during the last five years.

Although the paper cover of the book is slightly better than that on last year's edition, the book should be bought bound.

Publications Received

MAP COLLECTIONS in the District of Columbia, a mimeographed descriptive list, may be had without charge, so long as the supply lasts, from the Board of Surveys and Maps, Interior Department Building, Washington, D. C.

SPECIAL PUBLICATIONS Nos. 158, 159 and 161, U. S. Coast and Geodetic Survey, are thin illustrated pamphlets on Bilby Steel Tower for Triangulation, The Bowie Method of Triangulation Adjustment, and First-Order Leveling in Hawaii. (10, 15 and 10c. each from the Superintendent of Documents, Washington, D. C.)

PROGRESS IN ENGINEERING is the subject of an address by Wm. Barclay Parsons, published by Columbia University, New York City. The address was one of a series of lectures on A Quarter Century of Learning arranged for by the committee in charge of the celebration of the 175th Anniversary of the Founding of King's College.

FIFTY-FIVE PAGES of the January *Journal* of the Institute of Canada (2050 Mansfield St., Montreal) are filled with an illustrated article on Fabrication and Erection of the Superstructure of the Montreal-South Shore bridge, by L. R. Wilson, vice-president in charge of operations, Dominion Bridge Co., Montreal, Canada.

SURFACE WATER SUPPLY OF CANADA: Water Resources Papers—No. 58, St. Lawrence and Southern Hudson Bay Drainage, Climatic Years 1925-26 and 1926-27. No. 59, Pacific Drainage, 1926-27. Paper; 7x10 in.; pp. 390 and 242, each with key map and folding map. Free, from Dominion Water Power and Reclamation Service, Ottawa, Canada.

THE FIRST NUMBER of the *Journal* of the Engineering Societies of Boston appeared this month. The publication will be issued monthly except in July and August. Besides announcements of the various societies, the *Journal* will publish articles. ($1.50 per year, from Engineering Societies of Boston, Tremont Temple, Boston, Mass.)

A SUMMARY OF LITERATURE on the Use of Calcium Chloride or Sodium Chloride as a Protection for Mortar or Concrete Against Frost, by W. N. Thomas, has been published by the British Department of Scientific and Industrial Research. It fills 30 pp., including a bibliography with 27 entries. (9d. from British Library of Information, 5 East 45th St., New York City.)

THE SUMMARY OF CURRENT LITERATURE on water supply, sewage, trade wastes and river pollution, issued for two years past in neostyled form (supply exhausted), began to appear as monthly pamphlets in January, 1930, according to an announcement of H. T. Calvert, director of water pollution research, British Department of Scientific and Industrial Research. (1½s. per number or 15s. per year from British Library of Information, 5 East 45th St., New York City.)

THE AMERICAN CONCRETE INSTITUTE has discontinued publication of its *Proceedings* as an annual and substituted a journal to be published monthly except in July and August. The first issue appeared under a November date line. It is edited by the secretary with the direction of a publication committee. The first 12 pp. are devoted to current developments in the concrete field and news of committees and of society business. There follow five committee reports and one paper.

MUNICIPAL SANITATION: A Journal for the Practical Sanitary Official, joined the ranks of technical monthlies in January. Besides Abel Wolman as editor and Fred Shepperd as editorial director, its masthead carries the names of an advisory board of twelve, with George W. Fuller as chairman. Articles in the first issue are: How New York Handles Her Garbage and Rubbish Problem, by Kenneth Allen; The Function of the City Sanitary Engineer, by Joel I. Connolly; Investigation of Pipe Sewer Failures Develops Some Interesting Data, by Robert B. Morse; Modern Housing for Negroes—A Chicago Experiment, by Alfred K. Stern; The Engineer and Municipal Street Cleaning, by Covington K. Allen. Department heads are The Round Table, devoted in this issue to cleaning catchbasins, and News of the Month. New York: Case-Shepperd-Mann Publishing Corporation, 225 W. 34th St.; $1 in United States and Canada; $2, foreign.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

AMERICAN RAILWAY SIGNALING PRINCIPLES AND PRACTICES: Seven pamphlets. New York: Signal Section, American Railway Association. Paper; 6x9 in.; illustrated. Price 10 to 20c. each for railway employees; 20 to 30c. for others.

Advance printing of 7 of 26 chapters of a book designed to cover the entire field of railway signaling for employees in or candidates for the signal department.

AN AUDIT OF AMERICA: A Summary of Recent Economic Changes in the United States—By Edward Eyre Hunt. New

York and London: McGraw-Hill Book Co., Inc. Cloth; 5½x8 in.; pp. 203. $2.

THE BALANCING OF ENGINES—By W. E. Dalby, F.R.S., M.Inst.C.E., M.I.M.E., A.M.I.N.A., M.A., B.Sc., London University Professor of Engineering at the City and Guilds Engineering College of the Imperial College of Science and Technology. Fourth Edition. New York: Longmans, Green & Co. London: Edward Arnold & Co. Cloth; 6x9½ in.; pp. 321; 218 illustrations. $8.40.

In this edition Mr. Dalby has taken particular notice of the recent studies on impact stresses made by the Bridge Stress Committee in England. Accordingly, a new chapter has been included on the subject of vibration of railway bridges. The developments in this field have also occasioned a complete rewriting of the chapter on locomotive balancing. The treatment given to the subject of bridge vibration includes both theoretical considerations and the results of field tests.

DEUTSCHER REICHSBAHN-KALENDER 1930: IV. Jahrgang—Edited by Dr.-Ing. Hans Baumann, Berlin. Leipzig: Konkordia-Verlag. Paper; 6¼x10¼ in.; halftones and maps; pp. 160.

FLOW OF WATER IN DRAINAGE CHANNELS: Results of Experiments to Determine the Roughness Coefficient *n* in Kutter's Formula—By C. E. Ramser, Senior Drainage Engineer, Division of Agricultural Engineering, Bureau of Public Roads. Technical Bulletin No. 129, U. S. Department of Agriculture. Paper; 5½x9¼ in.; pp. 101; halftones, line cuts and tables. 40c. from Superintendent of Documents, Washington, D. C.

Numerous field measurements of ditches of various types are outlined. Values of *n* for use in designing ditches under seven governing conditions are listed.

FOUR YEARS' OPERATION OF THE MARION SEWAGE-TREATMENT WORKS FOR THE PERIOD ENDING JUNE 30, 1928—By Floyd G. Browne, Superintendent, Marion, Ohio. Paper; 6x9 in.; pp. 27; illustrations and tables.

The works include bar gratings, grit chambers, Imhoff tanks, trickling filters, secondary settling tanks and glass-covered sludge-drying beds. Total yearly costs for payroll, power and light, equipment and repairs and the three combined are given.

INVESTIGATION OF CRUSHED BLAST-FURNACE SLAG AS A MEDIUM IN SEWAGE TRICKLING FILTERS—By Charles C. Hommon, Consulting Sanitary Engineer, Canton, Ohio. Cleveland: National Slag Association. Paper; 6x9 in.; pp. 43; illustrated.

MASTERING A METROPOLIS: Planning the Future of the New York Region—By R. L. Duffus. New York and London: Harper & Brothers. Cloth; 5½x8¼ in.; pp. 302; halftones and maps. $3.

MECHANICAL WORLD YEAR BOOK, 1930. Forty-third Year. Manchester and London: Emmott & Co., Ltd. Cloth; 4x6¼ in.; pp. 180; illustrations and tables. 1½s.

PERMISSIBLE STRESSES ON RIVETS IN TENSION—By C. R. Young and W. B. Dunbar. Bulletin No. 8, 1928, Section No. 16. University of Toronto, Faculty of Applied Science and Engineering, School of Engineering Research. Paper; 6x9 in.; pp. 30; halftones, line cuts and tables.

PROPERTIES OF WESTERN HEMLOCK AND THEIR RELATION TO USES OF THE WOOD—By R. F. A. Johnson, Engineer, Forest Products Laboratory, Madison, Wis., and W. H. Gibbons, in Charge, Office of Forest Products, Portland, Ore. Technical Bulletin No. 139, U. S. Department of Agriculture. Paper; 6x9 in.; pp. 61; halftones and line cuts. 20c. from Superintendent of Documents, Washington, D. C.

RESULTS OF TESTS ON SEWAGE TREATMENT—By Harold E. Babbitt, Professor of Sanitary Engineering, and Harry E. Schlenz, Research Graduate Assistant in Civil Engineering, University of Illinois. Urbana, Ill.: University of Illinois, Engineering Experiment Station. Paper; 6x9 in.; pp. 98; illustrations and tables. 55c.

Imhoff tank studies, 1922-29, on deep and shallow tanks, covered drying beds, sedimentation under different conditions, gas production, including use of heat and digestion tanks.

STANDARD SPECIFICATION FOR STEEL STRUCTURES FOR BUILDING (Second Edition). Ottawa: Canadian Engineering Standards Association. Paper; 6x9 in.; pp. 39.

STRENGTH TESTS OF OLD DOUGLAS FIR TIMBERS—By E. H. McAlister, Professor of Mechanics. University of Oregon Publication, Mathematics Series, Vol. I, No. 2. Eugene, Ore.: University Press. Paper; 6¼x10 in.; pp. 56. 50c.

The timbers treated were from a covered bridge 53 years old.

A STUDY OF TESTS OF CYLINDERS AND CORES TAKEN FROM CONCRETE ROADS IN TEXAS DURING 1928—By John A. Focht. Engineering Research Series No. 27. Austin: University of Texas. Paper; 5½x8¾ in.; pp. 18; charts.

TIMBER DESIGN AND CONSTRUCTION—By Henry S. Jacoby, Professor of Bridge Engineering, Emeritus, Cornell University, and Roland P. Davis, Professor of Structural and Hydraulic Engineering, West Virginia University. Second Edition, partly rewritten. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9¼ in.; pp. 334; illustrated, mostly halftones. $4.50.

Letters to the Editor

Steel Floors for Buildings

Sir—The new steel floor for buildings described in *Engineering News-Record*, August 29, p. 326, by Lee H. Miller, and in a bulletin recently issued by the American Institute of Steel Construction is of interest chiefly because of its departure from established practice in structural steel design.

Quoting from the article: "By using 3-in. 5.7 lb. I-beams, spaced 24-in. centers, and a ⅜-in. plate, such a floor construction will carry a total load of 190 lb. per square foot, on a 10-ft. span, with a deflection of 0.07 in." In this example of the proposed construction we have a plate 24 in. wide with a cross-sectional area of 4.5 sq.in. acting as tee to an I-beam section 3 in. deep with a total cross-sectional area of only 1.64 sq.in. Such a disproportionate area of tee to I can hardly be accepted as sound engineering.

This point also leads to a consideration of the permissible ratio of effective flange width to flange thickness. In ordinary plate girder design the maximum permissible overhang is 6 in. beyond the outermost line of rivets, or eight times the thickness of the thinnest plate. In reinforced concrete eight times the slab thickness constitutes the effective flange width on one side of a tee beam. In Mr. Miller's example of the ⅜-in. plate welded to 3-in. I-beams, the full 24-in. width is considered as effective section, giving a ratio of flange overhang to plate thickness of about 60.

While the American Institute of Steel Construction bulletin states that "floor panels have been constructed and tested under load, and the results confirm the theoretical analysis as to strength and deflection, and also recovery when the loads are removed," the results of such tests, which have not, to my knowledge, been published, may not be interpreted as favorably by the profession at large as by the American Institute of Steel Construction.

It is stated in the *Engineering News-Record* article and in the bulletin referred to that "it is assumed that this combination construction will be made continuous over the top of the supporting girders, or by framing the small beams into the girders flush on the top, and having the plates continuous. The loads and deflections given are based upon fixed end supports and it can be demonstrated that this action will exist." So confident are the promoters of this floor construction of the existence of full fixity and end restraint that the tables they have incorporated in their bulletin are based upon this condition alone with only a footnote to call attention to the fact that the deflections for uniformly distributed load on simple span beams will be 3½ times the deflection values given in their tables.

Full fixity or end restraint depends on one of three conditions: (1) each span being supported at both ends by rigid connections to unyielding, rigid supports; (2) continuous construction over an infinite number of equal spans, all spans being uniformly loaded; (3) balancing moments in spans adjacent to the one under consideration being developed by compensating span lengths, dead-load effects, or attachment at distant supports.

The effect of (1) may be discounted at once, because the girders into which the floor will frame will not ordinarily furnish sufficient torsional resistance to insure unyielding, rigid supports. The conditions of (2) are seldom realized in the floor of a building; moreover, with a floor of slight dead weight, the effects of unbalanced live loads (3) are of real consequence, unless otherwise compensated for.

For buildings three bays in width, a condition common to schools, hospitals, apartments, hotels and even office buildings, and considering spans of equal length, a theoretical analysis shows the maximum positive moment in the outside spans to be nearly 1/10 WL and the maximum negative moment over the two interior supports to be approximately 1/9 WL, for a live load three times as great as the dead load. The negative moment in this case would determine the cross-section for all three spans.

Again, for buildings two bays in width, the maximum negative moment in outer spans will be ⅛ WL, which means that safe loads for these spans would be only two-thirds as great as the tabulated values in the bulletin for fully continuous construction.

Referring again to the example cited above and considering the case where 3-in. I-beams are framed into girders by means of shelf angle connections, the negative moment to be developed at this point is approximately 57,000 in.-lb., requiring the weld to develop a stress of about 18,400 lb. For a shelf angle with 3-in. outstanding leg the maximum length of bead weld would be 6 in., which, according to various tests

would require a ⅜-in. weld. It is difficult to see how the flange of a 3-in. 5.7-lb. I-beam could accommodate a weld of this dimension.

It is to be noted also that no consideration has apparently been given by the promoters of this floor construction to reduction of unit flange stress in negative bending to provide against flange buckling at supports.

While it is possible to design a floor of the proposed construction for the most unfavorable conditions of continuity and restraint, the resulting economy will be considerably less than for the ideal conditions assumed, and this important aspect of the matter should not escape the attention of those whose interests are at stake. Neither should the radical departure of this proposed construction from established engineering practice be overlooked.

G. A. MANEY,
Professor of Structural Engineering,
Northwestern University.
Evanston, Ill., Dec. 20, 1929.

* * *

Sir—Professor Maney's letter indicates that his judgment in this matter is apparently confused by his concrete design experience. He should readily admit that reputable engineers would not advocate an engineering proposition which had not been given careful thought and analysis by those skilled in steel design and construction.

The steel plate floor or beams are neither plate girder flanges nor reinforced-concrete tees, and it has not been proposed that they should function except as a part of a completed floor system that will act in accordance with sound engineering practice just as the web of a plate girder or the bottom plate of a bin. Plate girder webs are permitted to function at their full working stress where the ratio of thickness to distance between flanges does not exceed 1 to 60, and at reduced unit stresses where the ratio is from 60 to 160. Under these conditions the web plates have functioned to resist crippling, which is a combination of tension, compression and shear, and in addition they develop the flange stresses.

If engineering practice as exemplified by the use of steel plates in the bottom of large bins were to be followed, there would be no occasion for the small beams, except to eliminate flexibility. One of the largest and most experienced builders of steel bins forbids the use of stiffeners on the horizontal bottom plates where the bins are less than 18 ft. square and the plate ⅜ in. thick. Such bin floors support live loads in excess of 2,000 lb. per square foot, but the edges of the plates are rigidly supported against horizontal or vertical movement. It would be hard to devise a more rigid horizontal support than exists for the edges of any interior panels of the "battledeck" steel floor system, and with the vertical edges of the panels supported, a ⅜- or ¼-in. plate without stiffener beams would carry more than the tabulated loads given. Such floors, however, would be too flexible for ordinary uses.

While the tabulated data of the A.I.S.C. bulletin gives information relative to the single tee unit, it is evident that any single unit as a part of a floor panel has strength greater than that given, due to the fact that a single unit could not deflect without distorting the whole floor panel. The directions in which stresses act in the plane of the plate, due to concentrated or uniform loads, in such a floor panel are infinite. The experimental panels which have been subjected to test loads confirm this, since the deflections are less than those given in the tabulated data.

Professor Maney discusses in more or less detail the conditions of fixed-end and continuous beam actions, which are recognized and questioned by engineers of steel construction. It is difficult to understand how he concludes that, because we warn the user of the tabulated data with a footnote that the data apply only to fixed end construction and that simple span deflections are different, we are trying to deceive the user of the tabulated data into believing that it is impossible to use this floor as a simple span. He refers to the possibility of buckling of the compression flange at the point of negative moment, and to the difficulty of providing continuity for the compression flanges at the points of support. These questions and many others that Professor Maney has not referred to have been carefully considered in the development of this floor design, and there is no difficulty in meeting the physical or technical requirements.

An analysis of the stresses which exist in the plates of the battledeck floor construction will reveal that they are, as plates, seldom required to function at a stress equaling 4,000 lb. per square inch.

LEE H. MILLER,
Chief Engineer,
Am. Inst. Steel Construction.
Cleveland, Ohio, Jan. 25, 1930.

Tree Rings and Long-Term Rainfall Records

Sir—Extending rainfall records back into the past, qualitatively if not quantitatively, is suggested as a possibility by the article on tree rings of the Southwest by Dr. Andrew Ellicott Douglass in the December *National Geographic Magazine* (pp. 736 to 770). The effect of rainfall on the thickness of the annual growth rings of trees is apparently quite measurable for the semi-arid regions of the Southwest. Perhaps it has some effect elsewhere.

Study of tree rings in current lumbering operations in Washington and Oregon, for example, might disclose a measurable difference between those developed during the wet years about 1878 and those for the dry years since 1922, comparing the tree rings with rainfall records such as that of Seattle, published in *Engineering News-Record*, Jan. 9, 1930, p. 61.

Such a study, if it showed anything, ought to establish whether or not the present low precipitation of the Northwest is really abnormal when viewed from the long-term standpoint. Such knowledge might well be of considerable value to municipalities, power companies and other users of streamflow. The study need not be limited to any particular locality.

F. B. MARSH,
With Board of Water Supply.
New York City, Jan. 14, 1930.

Restricting the Practice of Engineering

Sir—In reply to the article entitled Restricting the Practice of Engineering, in your Jan. 30 issue; making speeches and writing letters is getting the engineer nowhere.

When an appeal was made to the engineers of this state for funds to go into the courts to establish their rights, out of 10,000 engineers approximately $200 was collected to fight the battle. The fault is not with the courts nor with the architects, but with the engineers themselves, who pat themselves on the back and say they are very remarkable fellows, but nothing in this country is gained without a fight. The major societies, which have large treasuries, are not contributing a dime to the battle on behalf of the engineers, but are issuing papers on the oxidizing of iron, the luminizing of concrete or some other such subject, that fits in well with those who care to read papers and carry a little badge on their vests indicating that they are members of this or that national society.

It is all wrong; a fight belongs to the engineers as a whole, not to the individual. The writer personally has carried a fight into the courts, and when the engineer is ready to put up money to establish his rights, something will be accomplished, not by letter writing to magazines nor by shouting from the roof tops.

DAVID M. OLTARSH,
Consulting Engineer.
New York, N. Y., Jan. 31, 1930.

Delaying Setting of Test Specimens

Sir—I was interested in reading Miles N. Clair's letter in your issue of Jan. 16 in connection with my article in the issue of Nov. 28, 1929.

Mr. Clair's suggestion is a valuable one, for I know that he is correct in stating that sugar retards if not indeed destroys the setting of concrete. As Mr. Clair states, by adding a known amount of sugar, which weight is deducted from the sample when the test is made, the sample can be set aside without danger of its hardening to prevent making the test.

I have not experimented with sugar but have read of its effect on the setting of concrete. I have, however, made tests using honey water solutions and found that weak solutions affect slow setting but that a strong solution (50-50) accelerates the setting.

GEORGE J. GRIESENAUER,
Cement Tester C., M., St. P. & P. R.R. Co.
Chicago, Ill., Feb. 2, 1930.

News of the Week

New Branch Railway Approved

Construction by the Pittsburgh & West Virginia Railway of a branch line into the Donora industrial district on the Monongahela River has been authorized by the Interstate Commerce Commission. The line will extend from the Pigeon Creek crossing on the Connellsville extension to a connection with the Donora Southern Railroad at a point near the river to be known as Baird. As surveyed, the branch will be 5.79 miles long and its cost is estimated at $1,397,030. The commission said that approval given to construction of the Donora branch should not be construed as a finding in favor of the construction by the Pittsburgh & West Virginia of an extension to Monessen, also projected.

West Virginia Plans New Capitol

Bids will be opened March 5 by Gov. William G. Conley of West Virginia for the erection of the main unit for the new state capitol at Charleston. The central part of the building will be 536 ft. long by 150 ft. wide, with a dome rising 266 ft. above the surroundings. At each end will be a wing 94x66 ft., one story in height. These wings will form connecting links between the main unit and other sections recently completed and now occupied.

Alternate Methods Proposed for Narrows Tunnel Construction

Following a public hearing in New York City Feb. 14, two separate plans for the proposed vehicular tunnel to run under the Narrows between Brooklyn and Staten Island were forwarded to Washington for approval by the War Department. The city requests that both plans be approved, so that it may have the alternative of constructing the tunnel by either the shield or the trench method. The latter, it is stated, would be cheaper by about $8,000,000, but would decrease the channel depth from the present 80 ft. to between 50 and 60 ft.

A description of the proposed tunnel was given in *Engineering News-Record* June 20, 1929, p. 1001. Preliminary plans call for twin tunnels, each tube carrying two lines of vehicles, with an underwater diameter of 31 ft., which is reduced to 29 ft. 6 in. in the approach tubes. The estimated cost for the complete structure, including real estate, is placed at $77,900,000 when constructed by the shield method. At the preliminary hearing the approval of the project was voiced by representatives of the U. S. Navy, the Port of New York Authority and the Baltimore & Ohio Railroad.

Canadian Engineers Hold Interesting Meeting at Ottawa

Engineering Institute of Canada Told of Part of Profession in Dominion's Development

WITH more than 600 members of the engineering profession from all parts of Canada in attendance, the 44th annual meeting of the Engineering Institute of Canada was held in Ottawa Feb. 12-14. A feature of the meeting was the election to the presidency of A. J. Grant, engineer in charge of the construction of the Welland Ship Canal. It is a happy coincidence that Mr. Grant should be chosen to preside over the destinies of the Institute during the year in which the big ship canal will be completed. Mr. Grant succeeds C. H. Mitchell, dean of the faculty of applied science and engineering of the University of Toronto.

Mr. Mitchell's retiring address, in which he reviewed Canadian engineering development and forecast its future, was another high light of the meeting. He told of the important part taken by engineers in the progress and development of the country, gave a review of the principal engineering works now actively in progress, and predicted a great expansion of the field for professional activities in the immediate future.

H. Marshall Tory, chairman of the National Research Council, dealt with the purpose and work of that organization, involving the co-ordination of work being done by investigators throughout the country. Its purpose is to make available to Canadian industry and economic life the fruits of its scientific research. The British airships "R-100" and "R-101" were described in an address by Group Captain E. W. Stedman, chief aeronautical engineer of the National Defence Department. A six-wheeled truck was described in a paper read by Capt. N. O. Duckett, of the Royal Military College, and a demonstration to show its practicability for deep snow traveling was given. F. T. Peters, surveyor general, Department of the Interior, spoke on "The Engineer's Work of Surveying and Mapping," and A. M. Narroway, chief aerial surveys engineer of the Department of the Interior, on "Aerial Surveying."

Hydro-Electric Resources

At the final session Norman Marr, chief hydraulic engineer of the Dominion Water Power and Reclamation Service, presented a paper on "Canadian Water-Power Resources." He predicted that hydro-electric development would reach an installed capacity of more than 10,000,000 hp. by 1940, basing his estimate on current undertakings and the rate of progress during the past six years. R. deB. Corriveau, assistant engineering chief of the Department of Public Works, gave a detailed description of the 205-ft. mooring mast located at St. Hubert in the Montreal area. The design provides for a maximum pull at the tower head of 90,000 lb., amply sufficient to secure safety, as the "R-100" exerted a maximum pull of 33,600 lb. when riding a gale recently at the top of the Cardington mast, in England. For filling the gas bags of the "R-100" full provision has been made in an adequate hydrogen-generating plant capable of supplying up to 60,000 cu.ft. of hydrogen per hour.

Railway Leader Speaks

The principal speaker at the annual luncheon of the Institute was Sir Henry Thornton, K.B.E., president of the Canadian National Railways. Dealing with the engineering profession, Sir Henry declared that the first prerequisite in an engineer was imagination. It was he who must first dream dreams and, having done so, bring these into tangible expression. In all construction work the most important factor was the engineer. He was of greater value in the construction of a railway than the financier who found the money, or the subsequent operating officers, for his work, with all its virtues and its faults, remained for all time. Few departures from ethical standards had ever disgraced the engineering profession, said Sir Henry. There was no calling in which greater loyalty and fidelity to tradition had been exhibited.

Another feature of the convention was the adoption of a resolution by which the Institute will endeavor to secure co-ordination of the different professional engineering associations throughout Canada. The resolution was moved by S. G. Porter, Calgary, Alta., chairman of the committee on relations of the Engineering Institute of Canada with the seven provincial associations of professional engineers. Mr. Porter pointed out that there was much overlapping and conflicting of interests between the Institute and these seven provincial associations of engineers.

The convention was brought to a close by a banquet in the evening, at which the principal speakers were C. A. Dunning, Minister of Finance; Charles Stewart, Minister of the Interior; T. A. Crerar, Minister of Railways; Norman R. Fisher, president of the Canadian Institute of Mining and Metallurgy; P. E. Nobb, president of the Royal Architectural Institute of Canada; and G. R. Mickle, president of the Association of Professional Engineers of Ontario. President A. J. Grant officiated as toastmaster.

Start Surveys for New Yakima Irrigation Project

First public announcement of the project of the Indian Irrigation Service for development of a new irrigation project to cover 35,000 acres of rich volcanic ash lands on the Yakima Indian Reservation, in Yakima County, Wash., has been made through formal notice to Charles J. Bartholet, state hydraulics supervisor, by L. M. Tolt, Yakima, supervising engineer of the Indian Irrigation Service, that surveys are to be commenced. The plan outlined provides for taking the waters of the Klickitat River and Diamond Branch from a short distance above their junction, carrying them through the adjoining hills by a tunnel several miles long, and then turning them into the North Fork of Simcoe Creek to be conveyed to the edge of the district, from which point canals will serve. One canal will be carried northward from the creek along the hillside through the Ahtanum ridge into Ahtanum Valley, where settlers have long needed water. The Simcoe district is now but sagebrush.

Power possibilities are mentioned in the government notice. The high elevation of this water source, about 3,500 ft., permits reclaiming lands not previously accessible from other water sources which have been used to develop large sections of the Yakima Valley.

Report Advises Reorganization of Seattle Lighting Department

Following a detailed investigation of the municipal light department of Seattle, Wash., the firm of Lybrand, Ross Brothers & Montgomery, efficiency experts, has submitted a report advising the complete reorganization of the department under either a superintendent or a non-salaried utility commission. Inefficient practices charged to the present administration are due, according to the report, to the fact that the department head is burdened with too many details and the direct supervision of too many activities, and that there is not a proper division of authority and responsibility, nor an effective use of such staff organization as exists at present. Consolidation of local power plants, both municipally and privately owned, is recommended. Failing this, the experts propose a conference between responsible heads of the city and the private power plants in order to eliminate unnecessary duplication of facilities and certain uneconomical concessions said to have been made in order to secure business. Adoption of a long-time construction program to cover necessary expansion, so as to remove this matter from the realm of controversy in changing councils and administrations, is also urged.

A simultaneous report was presented by J. D. Ross, superintendent of the lighting department, in which it was charged that interference from the city council and the city engineering department had been responsible for many costly mistakes and delays for which the department had been blamed. Mr. Ross urged that his department be given full charge of engineering connected with the city light construction, stating that work of this character handled in the past by the city engineering department has been slow and unsatisfactory.

Dean Snow, of N.Y.U., Resigns After 33 Years

Charles H. Snow, for 35 years dean of the college of engineering and who was also dean of the Guggenheim school of aeronautics at New York University, has resigned. He will be designated professor emeritus of civil engineering.

Born in New York City in 1863, Dean Snow graduated from New York University in 1886. He was selected to succeed Charles B. Brush, professor of civil engineering, in 1892, and shortly thereafter was instrumental in the establishment of a separate department of engineering, of which he was soon made the head. At that time the college of engineering had twenty students. Today the enrollment numbers 750 full-time students with 500 special students in the evening engineering division. Dean Snow is a member of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers and the American Society of Military Engineers, and a fellow of the American Association for the Advancement of Science.

DEAN SNOW

Dean Snow will be succeeded by Collins P. Bliss, who has been associated with the college of engineering since 1896 and associate dean since 1927. Dean Bliss had a major part in initiating the aeronautical course at the university, securing the co-operation of leading industries of the country in equipping the building entirely without cost to the university. He was graduated from Princeton in 1888, studied at the Columbia school of mines, was graduated from the Columbia school of architecture in 1891 and received a master's degree from Princeton the same year. The new dean is a member of the American Society of Mechanical Engineers, the Society for the Promotion of Engineering Education and the National Aeronautical Society.

Birmingham Votes Bonds for Airport and Drainage

Bond issues totaling $4,000,000 were approved by the voters of Birmingham, Ala., Feb. 11, for the purpose of building a 300-acre airport at a cost of $1,000,000 and the construction of a drainage project affecting 48 of the city's 52 square miles of area.

Arkansas Engineers Hold Annual Meeting

A program of technical papers by visiting engineers, with discussion by the membership, was carried on at the annual convention of the Arkansas Engineers Club at Little Rock Feb. 13-15. Attendance exceeded 150. The four general subjects under discussion were waterways and flood control; highways; water supply and sewage disposal; and aviation.

Lieut.-Col. F. B. Wilby, district engineer, U. S. Engineer Office, Memphis, Tenn., compared the cost and effectiveness of the spillways contemplated by the Jadwin plan with those of the reservoir plan advocated by some critics of the Jadwin plan. He pointed out that one of the reservoirs advocated would submerge approximately 955 square miles near Little Rock and would occasion an expenditure of probably $250,000,000. B. E. Gray, state maintenance engineer, Charleston, W. Va., gave a paper on the design and construction of asphalt pavements, with particular reference to low-cost roads. A paper on the design and construction of concrete pavements was given by H. E. Frech, Portland Cement Association, St. Louis, Mo. Justin Matthews, of Little Rock, talked on the Mississippi Valley Association and the commercial benefits of river navigation. W. W. Horner, chief engineer, streets and sewers, St. Louis, Mo., gave a paper on the present trend in municipal sewerage and sewage disposal. The purification of small community water supplies was discussed by H. B. Crane, International Filter Co., Chicago, Ill. Airport design was discussed by O. S. Edington, of the firm of B. Russell Shaw, airport engineers, St. Louis, Mo.

Officers elected for the coming year include: president, Dewoody Dickinson, consulting engineer, Little Rock; vice-president, W. L. Winters, consulting engineer, Fort Smith; secretary-treasurer, W. Terry Feild, consulting engineer, Little Rock.

Ten Societies in Minnesota State Federation Hold Convention

For nine years the various technical organizations of Minnesota have met annually as the Minnesota Federation of Architectural and Engineering Societies. This year the federation, 100 strong, met Feb. 14 and 15 in Duluth. The program was diverse, covering subjects varying from the curing of concrete, electric welding and the erection of the lift bridge at Duluth on the one hand to aerial transportation progress in Canada and a testing laboratory's methods of testing contractors' hardware on the other. Architecture was represented by an essay on the place of and need for the architect in the design of all kinds of structures. L. W. Wallace, executive secretary, American Engineering Council, spoke on "The Engineer's Contribution to the Federal Government," his talk being a résumé of the

extent to which practically all departments, bureaus, commissions and commitees of Congress draw on the engineering profession for guidance. Although the question of joining the American Engineering Council has been under consideration for some time, no action was taken, the committee on the subject being continued.

The board of directors of the ten societies represented in the federation elected the following officers for the ensuing year: president, F. A. Wildes, of the Engineers Club of Northern Minnesota; vice-president, L. O. Painter, of the Engineers Society of St. Paul, E. J. Hawley, of the Minnesota Surveyors and Engineers Society, and L. B. Bersback, of the Minnesota chapter, American Institute of Architects; treasurer, B. J. Robertson, Minneapolis section, American Society of Mechanical Engineers. The secretary, Miss Katherine Feucht, and the editor, George H. Herrold, were re-elected.

One of the earliest accomplishments of the federation was a registration law for architects, engineers and land surveyors. Paul Doty, chairman of the State Board of Registration, presented copies of his ninth annual report for the year ended Dec. 31, 1929, in which he stated that "the value of the law is becoming recognized as shown by the increasing respect and consideration that is extended to registered professional men by municipal authorities, the courts and the public generally." During the year the board received 40 applications, granted 16 architectural, 14 engineering and 2 land surveying registrations. The present roster shows the following number in the various classes: 173 architects, 9 architects and engineers, 190 engineers, 84 engineers and surveyors and 20 land surveyors. Of the 416 total 117 are residents of 21 states other than Minnesota.

British Firm to Prepare Plans for Greek Reclamation Project

Plans for land reclamation and irrigation projects in seven different districts of Greece with a total estimated cost of $30,000,000 are to be prepared by Henry Boot & Son, Sheffield, England, for the Greek government. The aggregate area involved is approximately 6,000 square miles, including the following districts: Thessaly and the adjoining watersheds and lakes; the watershed of the rivers Louros and Arachthos in Epirus; the watershed of the River Acheron and the Margariti marshes, in Epirus; lakes Jannina and Lapsista, in Epirus; the plain of Platania and Kalimbari, in Crete; and the plain of Messara, in Crete.

According to the agreement reached, separate studies are to be prepared for each of these areas within two years, the report including cost estimates and recommendations as to the feasibility of the work. Each of the proposals will be considered separately and, should the government decide to proceed with the work, the projects will be carried out under the supervision of the same firm.

C. T. Hutchinson, President McGraw-Hill Company of California, Dies

C. T. HUTCHINSON, president of the McGraw-Hill Company of California, died suddenly at his home in Oakland just before midnight on Feb. 12. His death came as a shock to all his friends and associates and as an unexpected loss to the field of technical publishing, with which he had been connected for many years.

C. T. HUTCHINSON

Born in San Francisco in 1876, Mr. Hutchinson completed his schooling in the Polytechnic High School of that city and then entered the employ of the Union Iron Works. Proceeding through successive promotions he became assistant superintendent, superintendent, sales engineer and finally manager of the mining machinery department. From 1907 to 1912 he was manager of the mining machinery department of the Joshua Hendy Iron Works, San Francisco.

In 1912 he entered the journalistic field, and until 1915 was editor of *Western Engineering*; from 1915 to 1922 he was vice-president and general manager of the Dewey Publishing Co., publisher of *Mining and Scientific Press*, *Western Engineering* and *Metal Trades*. In 1922 he joined the McGraw-Hill Company of California as vice-president and general manager and as editorial director of *Journal of Electricity* (now *Electrical West*). On Nov. 22, 1926, Mr. Hutchinson was elected president of the company.

Besides noteworthy achievements in the earlier part of his career as an inventor and writer in the mining field, Mr. Hutchinson was a past-president of the San Francisco Electrical Development League, a member of the executive committee of the Pacific Coast Electrical Association and chairman of the California Electrical Bureau. In 1915 he was made a member of the A.S.M.E. board of managers for the International Engineering Congress.

To Mr. Hutchinson's business ability, high standards of dealing and knowledge of the technique of engineering were added sterling personal traits, including a cheerfulness, companionability and never-failing sense of humor which, evinced both in work and at play, gained and kept for him many friends.

Ford Succeeds Adams as Regional Plan Director at New York

Following the resignation Jan. 29 of Thomas Adams, general director of the Regional Plan Association, a citizens organization pledged to the practical realization of the regional plan of New York and its environs, George Burdett Ford was appointed to succeed Mr. Adams. At the same time Wayne D. Heydecker, formerly field secretary of the Regional Plan, was appointed associate director.

Mr. Ford, who has been identified with the Regional Plan since its inception, was a member of the group which made preliminary studies of the region in 1923 and has been a consultant to the committee on city planning of the Board of Estimate and Apportionment and to the commission on building districts and restrictions of New York City. He is president of the Federated National Societies on Planning and Parks and a past president of the National Conference on City Planning and of the American City Planning Institute. Mr. Ford has served more than thirty American cities, and has been decorated with the ribbon of the Legion of Honor for his services as consultant to the French government in the replanning of devastated cities following the World War.

Plan Vancouver Airport

Erection of one hangar, 110x80 ft., for land machines, and another, 120x80 ft., for seaplanes, has been approved by the airport committee of the city council as a minimum first development of the Vancouver civic airport. First plans include also an administration building, which will be added to later. Aprons, runways and landing strips, besides necessary work about the site, which is a waterfront property in a suburb south of the city, will bring the cost of the first stage of the airport to $246,000.

Brief News

A Bridge Across San Francisco Bay from the city of Richmond to Marin County, Calif., has been approved by the U. S. War Department. The structure, sponsored by Oscar Clatt, of San Francisco, will have a vertical clearance of not less than 175 ft. at mean high water for the main span, and horizontal clearances of 1,000 ft.

Iowa State Board of Engineering Examiners will hold an examination for applicants for registration March 20 and 21 in the Senate room of the state capitol, Des Moines. Requests for blanks should reach the secretary, W. C. Merckens, at Ames by March 5.

A New Engineering Building to cost $250,000 is one of the items in the expansion program of the University of Tennessee at Knoxville.

Sewer Bond Proposals involving an expenditure of $2,650,000 for the construction of trunk sewers will be voted on at the March election in Tacoma, Wash.

Storage Garages in apartment houses may now be constructed in Washington, D. C., without obtaining permission from adjoining property owners, under an amendment to the zoning code recently approved by the zoning commission. Plans for such garages must have the approval of the district commissioners.

Instruction in Aerial Photography is planned at Syracuse University as a result of a grant of $60,000 from the Guggenheim Foundation for the Promotion of Aeronautics. A course of study covering two years has been drawn up. A short course covering the theory and practice of taking, finishing and selling aerial photographs and photographic maps has also been announced by the Curtiss-Wright Flying Service, New York City, which will accept a limited number of students in a course planned to cover a period of eighteen weeks.

Funds for Road Construction in four sections of South Africa amounting to $4,866,500 are now being allocated, according to a report of the U. S. Department of Commerce. The appropriation, intended for the construction of trunk roads, will be divided among the Transvaal, the Cape Provinces, Natal and Orange Free State.

Twin Gas-Supply Pipes 1,400 ft. long were laid across the Rhine River in 24 days, in constructing a pipe line connecting the Ruhr district with Cologne, Germany. The pipes, of approximately 16 in. diameter, were laid in a dredged trench 10 ft. deep and 65 ft. wide.

The Entire Business District of the town of Port Allen, La., will be moved a distance of two blocks as the result of changes in the Mississippi River levee. The change will straighten one of the great bends in the river at that point. A similar though less drastic encroachment is scheduled for Plaquemine, 15 miles down the river, where 1,400 ft. of levee will be straightened.

Applications for appointments to research assistantships in the engineering experiment station of the University of Illinois will be received until April 1, 1930, by M. S. Ketchum, dean and director.

A Flood Gate with a length of 373 meters is nearing completion in the harbor of Bremerhaven, Germany. This required 26,000 piles with a length of 85 ft. each for the foundation.

A Grant of $600,000 has been made by the Canadian federal government to be applied on the construction of a vehicular toll bridge across the St. Lawrence River from Lachine to Caughnawaga. Plans for the structure, at an estimated cost of $1,800,000, were completed some time ago by the Quebec department of public works. Control of the project is in the hands of a special commission which has full power both as to construction and administration.

Enlargment of the Fourth Ave. tunnel in Pittsburgh, Pa., is planned by the Pennsylvania R.R. at an estimated cost of $1,500,000. The tunnel, originally built for two tracks in the days of smaller engines, is too small to accommodate two present-day locomotives abreast.

New Orleans' Municipal Auditorium, erected at a cost of $2,500,000, has been completed and turned over to the city authorities.

A Bridge over the Danube River near Beoguad-Semlin will be constructed by a group of six German firms at a contract price of £690,000.

Brown Coal (lignite) is being used for fuel in Europe's largest power plant, just completed at Golpa-Zschornewitz, which contains two turbo-generators with a rating of 100,000 kva. each.

Interconnection of coal and hydroelectric power stations in western and southern Germany with parts of Austria, Switzerland and Alsace-Lorraine has been completed by means of approximately 2,500 miles of transmission lines carrying 220,000 volts.

The Four Park Projects thus far adopted by the Passaic County (N. J.) Park Commission, according to Frederick W. Loede, Jr., engineer and secretary of the commission, have boundaries almost identical with those proposed in the Regional Plan of New York and Its Environs. The combined area of the parks is 1,400 acres.

ARIZONA SUSPENSION BRIDGE WITH PORTALS IN PIERS

Cables for this suspension bridge, built by the Arizona Highway Department near Dome, Ariz., were spun in a horizontal position on the ground and hoisted to the tops of the towers after completion. Each cable consists of three strands containing 290 No. 8 wires having an ultimate strength of 220,000 lb. per sq.in. and a working strength of 70,000 lb. per sq.in. Suspenders, of 1¼-in. galvanized steel suspension bridge cable, connect into the top chords of the lower stiffener trusses. The bridge has a main span 800 ft. from center to center of towers with approaches consisting of a 114-ft. pony truss on the north and 57-ft. pony truss on the south. The floor system consists of 2x4-in. laminated flooring supported on ten lines of 4x16-in. timber stringers. A sand asphalt wearing surface ½ in. thick is provided. The final estimate on the contract price for this structure is $155,670, exclusive of engineering costs. The roadway has a clear width of 16 ft. between handrails.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Flood-Control Hearings — No Action Taken on Boulder Dam Problems — Railway Matters

FOUR days of hearings before the flood-control committee of the House of Representatives developed conclusively that there is general dissatisfaction with the Jadwin plan for controlling floods on the Mississippi, but the hearings also revealed that there is no unanimity of opinion in the lower valley as to modifications. Harry Jacobs, chief state engineer for Louisiana, explained his plan in detail, but it called forth objections of a determined character from Representative Whittington, of Mississippi, a member of the committee. Mr. Whittington insists upon the diversion through the Boeuf basin. To increase levee heights and carry the entire flood flow to Old River in the main channel, he contends, would be prejudicial to Mississippi's interests because it would greatly increase the backwater area in the Yazoo Delta. M. B. Montgomery, representing local interests in the Yazoo region, however, stated that he is not asking that the delta be benefited by diverting water onto Louisiana lands. It was his contention that the federal government should construct an adequate levee system to protect the land on the Yazoo and its tributaries without requiring local contributions. Representative Collier appeared to urge the closing of the Brunswick gap so that the levee line would extend to Vicksburg.

Reservoirs Advocated

Witnesses from the Tensas basin are placing chief reliance upon securing enough reservoirs on the Arkansas and White rivers to make unnecessary the diversion through the Boeuf basin. If the reservoirs are found to be impracticable and if it should be proved by exhaustive and unbiased surveys that a diversion is necessary, it is urged that the narrow controlled floodway be installed to begin to operate at a point 2 ft. above bankfull stage. While no representative of the Corps of Engineers testified at the hearing, it is known that that plan runs counter to thought in that agency. The Army Engineers point out that the diversion is to take care of crests. To be effective the floodway should be held empty, so as to allow the maximum of reservoir capacity.

Senators Harrison and Stephens, of Mississippi, also appeared before the House committee to urge that there be no elimination of diversion through the Boeuf basin. Senator Harrison stated that he had an agreement with those in charge of the flood-control bill when it was in the Senate under which the Boeuf diversion, with its benefits for Mississippi, was to offset the possibilities of damage to interests of that state by the Bonnet Carré spillway. It was with that understanding that he withdrew his objections to the diversion into Lake Pontchartrain. He told the committee, however, that he would oppose any diversion at Bonnet Carré in excess of 250,000 cu.ft. Senator Ransdell, of Louisiana, who wants the Boeuf diversion eliminated if possible, urged the committee to "get the facts, then legislate."

Representing New Orleans, Mayor-elect Walmsley and John Klorer, an engineer who is one of the city commissioners, appeared to advocate the construction of a floodway below the city. Their idea is that this spillway would not be used except in an emergency. They expressed the opinion, however, that it would be good insurance to have preparations made to divert water below the city so that the flooding of a large area could be avoided should it again be decided to open the levee.

Colorado Water Allocation Still Unsettled

At last word, agreement between the states on the division of water from the Boulder dam project had not been reached. The Phoenix meeting adjourned early in the week with Arizona's long-standing contentions practically satisfied. But the Imperial Valley and Los Angeles interests are now contesting as to their share of the main stream waters. Arizona, according to Senator Hayden, who attended the meeting in Reno before it took up in Phoenix, is willing to concede California her 4,400,000 acre-ft. The difficulty is that of this quantity the Imperial Valley wants 4,400,000 and Los Angeles requires 1,100,000. Of course this deficit might be furnished from the 2,500,000 of unapportioned waters, but both parties contend that they cannot enter contract without definite assurance of adequate supply from the primary apportionment.

As to the letting of power contracts, it was desirable that an agreement should first be made. In event of protracted delay, however, there is some reason to believe that the Interior Department will proceed in the near future.

Salt Danger Negligible

Salt beds on the Boulder Canyon reservoir site will not appreciably affect the project waters, according to a report to the Bureau of Reclamation by F. L. Ransome, professor of economic geology at the California Institute of Technology. Dr. Ransome has served the bureau on many occasions as a consultant on dam foundations. His report is based on extensive field studies and is calculated to allay reports current in Los Angeles that the reservoir waters will become brackish.

The salt deposits in question are in the valley of the Virgin River, which will be flooded after the dam is built. The ratio of the surface area of salt outcrops to the reservoir area is less than 1 to 5,000. Under the severest assumption, says Dr. Ransome, a million tons of salt might be dissolved in the first year, but the actual quantity probably would not be half of that and would decrease in years following. Even this large quantity would raise the chloride radicle content only 13 parts per million, from 98 to 111. Although this is a high ratio compared with the soft waters found in the East, water is still potable up to 250 parts per million.

Wabash Upholds Previous Plan

Acting upon the Interstate Commerce Commission's judgment favoring creation of a fifth trunk line system in Eastern territory, the Wabash Railroad is carrying forward negotiations to effect a grouping that conforms "as nearly as may be" with the commission's consolidation plan. The commission was so advised this week by William H. Williams, chairman of the Wabash board, in reply to a suggestion that the Wabash, together with the Chesapeake & Ohio, the Baltimore & Ohio and the Delaware & Hudson, should withdraw consolidation applications submitted prior to publication of the official plan.

Stating that the commission's plan allocates to the Wabash all of the major roads included in the road's original plan and that the elimination of the Lehigh & New England and the Chicago & Illinois Midland does not in any way change its purpose, Mr. Williams informed the commission that the Wabash especially wishes to avoid any interruption in the continuity of the proceeding.

Railway Purchase Approved

By authorizing the Baltimore & Ohio Railroad to acquire control of the Buffalo, Rochester & Pittsburgh Railway, the Interstate Commerce Commission has approved a step that is in harmony with its consolidation plan, although this unification was accomplished in in another manner and did not take into account the complete plan. Acquisition of the B.R.&P. by the Baltimore & Ohio was opposed by the Delaware & Hudson, which had con-

The Business Outlook

Basic industrial activity continues to increase steadily, in part in anticipation of a good spring peak of consuming demand rather than on the basis of present pressure. In the latest week's records there are signs that general trade is lagging less behind industry. Car loadings and check - money turnover picked up early in February and commodity prices have tended to strengthen after acute weakness. Steel mill activity continues to increase at about the same rate as for the past few weeks, the average for the industry rising nearly 4 per cent for the week, from 77 per cent of capacity to 80 per cent. Structural steel demand continues at around 50,000 tons per week.

—*The Business Week*, Feb. 17.

tended that the allocation of any particular line can be made only after considering the relationship of that line to the plan as a whole. Both the Delaware & Hudson and the Baltimore & Ohio had concluded that paragraph 2 of section 5 of the interstate commerce act, authorizing acquisition of control by purchase of stock and other methods, was superseded in some degree by publication of the commission's complete plan. To this the commission has replied, in effect, that although it is now ready to receive applications for consolidation under paragraph 4 of section 5, paragraph 2 is still in full force and effect. The commission declined, however, to consider the status of an application under paragraph 2 for an acquisition of control which is not in conformity with the grouping of lines under its complete plan.

Control of the B.R.&P. will be effected by purchase of a majority of its capital stock from the Alleghany Corporation at a price of $14,263,216 plus interest less dividends since March 1, 1929, the date of the B. & O.'s contract with the holding company.

Personal Notes

WALTER N. FRICKSTAD, since 1919 senior highway engineer with the U. S. Bureau of Public Roads, with headquarters in San Francisco, has been appointed city engineer of Oakland, Calif., effective Feb. 6. He succeeds George N. Randle, who recently resigned. Mr. Frickstad served as assistant city engineer for the city of Oakland from 1907 until 1919.

G. W. MAKER, formerly manager of publicity of the Morton C. Tuttle Co., of Boston, has rejoined the Aberthaw Company of that city to become manager of sales promotion. Mr. Maker was with the Aberthaw Company for about twenty years previous to his going to the Morton C. Tuttle Co.

V. R. HAYES has been appointed division engineer for the Wabash Railway at Decatur, Ill., and R. P. LONG division engineer at Moberly, Mo.

HAROLD M. GOULD, consulting engineer to the traffic department, Detroit Police Department, has resigned to resume his practice as consulting electrical and traffic engineer.

W. P. WITT has been appointed assistant engineer in the office of the superintendent of highways for Madison County, Illinois.

E. H. LOOKER, formerly assistant engineer at Bellefontaine, Ohio, on the Cleveland-Indianapolis division of the Nickel Plate railroad, is now assistant engineer, maintenance-of-way, of the Peoria & Eastern, with headquarters at Indianapolis.

BERNARD L. CROZIER, formerly chief engineer of Baltimore, has been appointed the engineer member of a special committee named by the Baltimore Association of Commerce to study the possibility of constructing a bridge over Chesapeake Bay with private capital or by state financing, which has been suggested by Gov. Albert C. Ritchie. The other members of the committee are bankers and business men.

L. M. ADAMS, lieutenant-colonel, Corps of Engineers, retired, has been appointed port director of the port of Corpus Christi, Tex. He will be assisted by J. L. BOYD.

HARWOOD BEEBE, head of the Beebe Engineering Co., of Spartanburg, S. C., and president of the South Carolina Society of Engineers, has been chosen by the Spartanburg metropolitan commission as engineer for the district and will at once begin work preliminary to the construction of sewer lines and disposal plants, as provided for in the act creating the district.

RALPH C. CHANEY, previously engineer in charge of bridges and special work in the office of the city engineer, and engineer of the City Planning Commission, Columbus, Ohio, has recently been appointed county planning engineer in the office of Fred R. Williams, county engineer of Cuyahoga County, Cleveland, Ohio.

W. H. MIESSE has been appointed division engineer of the Terre Haute division of the Cleveland, Cincinnati, Chicago & St. Louis Railway, with headquarters at Washington, Ind.

C. A. HARRELL, newly appointed city manager of Portsmouth, Ohio, has been for the past two years executive assistant to the city manager of Cincinnati, Ohio. Previously he was on the staff of the National Institute of Administration of New York City.

ROY S. MACELWEE, for the past several years commissioner of port development of Charleston, S. C., has been honored by the king of Belgium, who conferred upon him the Order of Leopold II, grade of officer, for services in connection with recent port and ship canal developments in that country.

Society Calendar

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; annual meeting, Chicago, Ill., March 11-13.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; spring meeting, Sacramento, Calif., April 23-24.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, St. Louis, Mo., June 2-6.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; annual meeting, Augusta, Ga., March 31-April 2.

ASSOCIATION OF STATE GEOLOGISTS met Feb. 13 and 14 at the U. S. Geological Survey offices in Washington. Topographic mapping was one of the principal topics, as the states do not make their own maps and, under prevailing agreements, co-operate with the topographic branch of the Survey, representatives of which were present at the conference. Appropriational matters were discussed in this connection. Another function of the meeting was to arrange for the joint handling and tying in of geological surveys crossing state lines.

CANADIAN SECTION, American Water Works Association, will hold its annual meeting March 12-14 at Hamilton, Ont.

DOMINION LAND SURVEYORS ASSOCIATION in convention at Ottawa elected W. M. Tobey president. Vice-presidents for 1930 are H. G. Beresford, T. S. Nash and J. A. Founder. W. L. Macliquhan, of Ottawa, was chosen secretary, and honorary membership was conferred upon A. O. Wheeler and L. E. Fontaine. The importance of a single standard of mapping throughout the dominion and the rapid increase in the use of airplanes in surveying and mapping were points stressed at the meeting.

ENGINEERS' CLUB OF SEATTLE, Wash., at its recent election chose the following officers for the ensuing year: president, J. R. West, chief engineer, Port of Seattle; vice-president, W. F. Way, engineer with Henry & McFee, contractors; secretary, J. T. Dovey; treasurer, R. W. Finke, assistant resident engineer, Northwestern Portland Cement Co.

KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS has elected Neff Jenkins, of the Jenkins Construction Co., Elizabethtown, its president, and has chosen as vice-presidents W. W. Carter, Dunmor, and J. B. McLellan, Bowling Green. Offices of the association will be moved from Louisville to Frankfort on March 1.

MATERIALS HANDLING will be the subject of a special meeting of the American Society of Mechanical Engineers to be held March 5-7 at Chicago in conjunction with the National Industrial Exposition of material-handling equipment.

NEW YORK STATE CHAPTER, Associated General Contractors, highway division, will hold its annual convention March 12-13 at Syracuse, N. Y.

TACOMA SECTION, American Society of Civil Engineers, has been granted a charter and has elected the following officers for 1930: president, J. L. Stannard, chief engineer of public utilities, city of Tacoma; vice-president, Homer O. Blair, consulting engineer; secretary-treasurer, Julian A. Arntson, senior engineer, city of Tacoma.

Obituary

WILLIAM ALLISON SWEET, of Rochester, N. Y., architect and engineer associated with Gordon & Kaelber, of that city, died on Feb. 12. Mr. Sweet was a native of Troy, N. Y., and went to Rochester six years ago. He worked on plans for many of the most important buildings in that city. He was a member of the Rochester Society of Architects and the Rochester Engineering Society.

LINTON W. STUBBS, who was engineer in charge of the construction of the Galveston (Tex.) causeway, died Jan. 18 in Los Angeles, Calif., aged 74. Prior to the construction of the causeway he was engineer of the Queen and Crescent route of the Vicksburg, Shreveport & Pacific Railway, with headquarters in Monroe, La. From there he went to the Southern Pacific, to which he returned after completion of his work at Galveston. He retired about fifteen years ago.

WILLIAM LEE HEAD, of Clarksdale, Miss., chief engineer of the Yazoo and Mississippi Delta Levee Board for 25 years, died in Memphis, Tenn., Feb. 8, aged 57 years. Mr. Head built the Yazoo and Mississippi delta levee, which was the only one of the major levees which did not go out during the floods of 1927. He was born in Lafourche Parish, La., and went to Mississippi at the age of eight. He was graduated in civil engineering from Mississippi A. & M. College.

Construction Equipment and Materials

British Wood Preserving Body Proposed at Meeting

Formation in the United Kingdom of an association of those interested in wood preserving was proposed at a meeting held in London recently, according to a report of the U. S. Department of Commerce. Representatives from creosoting firms, the British Engineering Standards Association, railway companies, the Timber Trades Federation, the Forestry Products Research Laboratory and other interests spoke in favor of the project.

Concrete Pavement Yardage

A tabulation of concrete pavement yardage awarded during the month of January, 1930, is given below:

	Sq.Yd. Awarded During January, 1930
Roads	5,244,263
Streets	1,306,797
Alleys	43,517
Total	6,594,577

Corrections to Road Show Report

In justice to the manufacturers concerned two mis-statements and one omission from the description of the Atlantic City Road Show contained in *Engineering News-Record* of Jan. 23 and 30 should be corrected. The Dreadnaught power grader of the Good Roads Machinery Co. is driven by a 45-hp. motor, the 25-hp. motor mentioned on p. 163 being used only in the Autograder, a smaller and lighter machine. On p. 201 the reference to the asphalt emulsion used in the Hunt process of concrete curing is incorrect, since the material used is not an emulsion, but a compound of Trinidad type Lake asphalt, Bermudez asphalt and Gilsonite. The Hunt process was exhibited by McEverlast, Inc. In the section of the report devoted to engines, pp. 203-204, no mention was made of the large and varied exhibit of gasoline motors displayed by Hercules Motors Corporation.

New Developments

Develop Centrifugal Steel-Casting Process

Centrifugally cast steel slabs were produced in a recent demonstration held at the Canton, Ohio, plant of the Central Alloy Steel Corporation. The equipment consisted of a drum 7 ft. in diameter which was rotated at 300 r.p.m. Liquid steel poured into one end is thrown against the side of the drum, where it solidifies into curved slabs which, on cooling, are removed from the drum ready to go direct to the rolling mill. According to the inventor, Leon Cammen, this equipment takes the place of the ingot mold and eliminates the soaking pit and the blooming mill. It is possible to build the drums up to 30-ton capacity, according to the inventor.

Detachable Tracks Aid Trucks

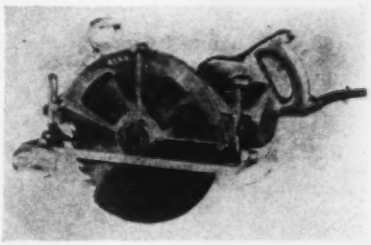
High speed on paved roads and greater traction under difficult conditions are the combined advantages of the type T Tructor, manufactured by the Tructor Corporation, Newark, N. J., for attachment to standard makes of motor trucks. To use this device it is necessary to attach an extra pair of auxiliary wheels under the frame of the truck. These remain in place permanently, carrying their share of the load and adding to the legal load limit of the truck. When heavy going is experienced, a chrome-nickel molybdenum steel track with an open, self-cleaning

DETACHABLE TRACK FOR MOTOR TRUCKS

design is wrapped around the two wheels on each side of the truck, giving the effect of crawler traction. Proper tension on the track is assured by a system of coil springs on the auxiliary wheels which keep the track tight regardless of the motion of the wheels, each of which is entirely independent. The tracks are easily detached by removing a single pin.

Power Saw Made in Two Sizes

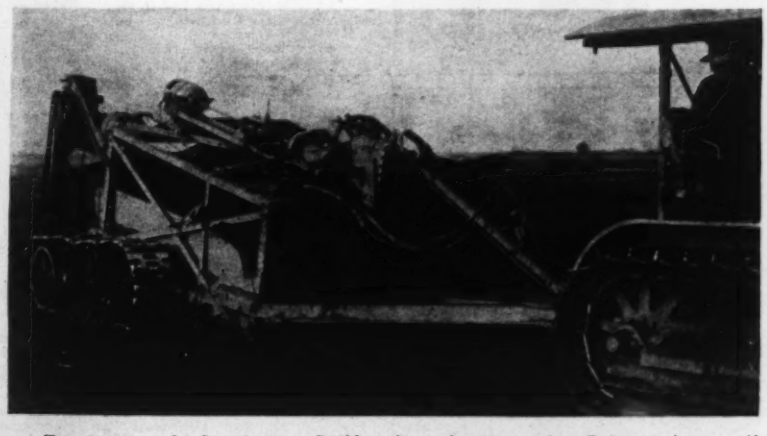
Portable electric saws with blades of 10 and 12 in. diameter for cutting depths of $3\frac{1}{8}$ and $4\frac{1}{8}$ in. have been developed by the Speedway Manufacturing Company,



ELECTRICALLY DRIVEN HAND SAW WITH 12-IN. BLADE

of Cicero, Ill. Both models are driven by General Electric motors running on either alternating or direct current, the smaller being of $\frac{3}{4}$ hp. and the larger of 1 hp. No-load speeds are 1,800 and 1,750 r.p.m. respectively. The two models are similar in design, each being fitted with a slipper base plate which can be raised or lowered to adjust the depth of cut; a swinging saw guard over the lower portion of the blade, and a fixed aluminum guard over the upper half which can be quickly removed by means of three narrow nuts which are so attached that they cannot be lost. Spur and bevel gears of heat-treated chrome nickel steel are used in place of the usual worm gears, and both machines are fitted with ball bearings. All gears and bearings are packed in grease. To give maximum visibility to the operator, saw blades are mounted on the left side of the machine, being driven through a driving flange of special design. Long cuts are facilitated by a rip-

ELECTRIC MOTORS OPERATE LARGE GRADER

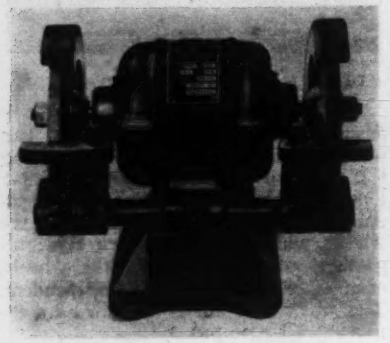


Guy Brothers, of Stockton, Calif., have built this electrically operated earth mover and leveler with a capacity of 12 cu.yd. Current is supplied by a generator on the tractor which draws the machine.

ping guide mounted on the front of the slipper plate. Both models are equipped with a D handle which is adjustable to two positions. Motor cases, handles and slipper plates are all of cast aluminum. Weights of the two units are 25 and 28 lb., respectively.

Portable Electric Grinder

Designed for general grinding purposes and tool sharpening, the new Red Streak portable electric bench grinder announced by Wappat, Incorporated, Pittsburgh, Pa., is light enough to move



LIGHT-WEIGHT ELECTRIC GRINDER WITH DOUBLE WHEELS

from place to place conveniently, yet of sturdy construction. The two 6-in. grinding wheels are covered with adjustable safety guards which make it possible to grind at any position on the circumference of the wheel. Particular attention is paid to balance in the design so that vibration is minimized.

Resistance of New Material Varies With Voltage

A new product which can be used either as an insulator or as a conductor of electricity has been developed in the research laboratory of the General Electric Company, according to an announcement made at the recent convention of the American Institute of Electrical Engineers. This material, called Thyrite, changes its resistance as the voltage of the applied current is changed, not with its temperature. Thyrite resembles black slate in color, and has mechanical properties similar to those of dry-process porcelain. In manufacture, the material is molded to the shape required, and the contact surface is coated with metal by a spraying process. The material can be used with either alternating or direct current, its characteristics are permanent, and it is expected that it will attain considerable use in lightning arresters for the protection of power stations. It is stated that a disk 6 in. in diameter and $\frac{1}{4}$ in. thick has a resistance of about 50,000 ohms at 100 volts, decreasing to less than $\frac{1}{2}$ ohm when the voltage is increased to 10,000 volts. Such a disk would carry lightning discharges having currents as high as 30,000 amperes without distress.

Business Notes

LUTEN BRIDGE CO., INC., has moved its business office from York, Pa., to Clarksburg, W. Va.

O. K. CLUTCH & MACHINERY CO., Columbia, Pa., has opened a Chicago office in charge of S. O. Nafziger.

GRAMM MOTORS, INC., Delphos, Ohio, has enlarged its administration offices to accommodate the national sales organization, formerly at Toledo, Ohio. The Toledo office is now a dealership for that territory only.

HAYNES STELLITE COMPANY, New York City, has made the following appointments: general sales manager, E. E. LeVan; works manager, J. H. Maguire; plant superintendent, F. T. McCurdy; assistants to the superintendent, J. R. Brown, F. L. Secord and Everett Page; research engineer, L. H. Brown.

PITTSBURGH TESTING LABORATORY, Pittsburgh, Pa., has appointed George J. Fertig director of its Southern laboratories at Birmingham, Ala.

ARTHUR J. HERSCHMANN, New York City, has discontinued his connection with the Limited Company, formerly the Skoda-works, and is now representing the Witkowitz Steelworks in Czechoslovakia.

HEADLEY EMULSIFIED PRODUCTS CO., Philadelphia, Pa., has appointed M. D. Tracy general sales manager. The company is planning to develop an extensive sales and distributing organization covering domestic and foreign trade.

LINK-BELT CO., Chicago, Ill., has opened a branch office in Vancouver, B. C., in charge of Frank B. Wetherill.

R. G. RICHMOND, general manager of the Waterbury Co., New York City, has resigned upon the completion of 25 years of executive and sales development work.

AUSTIN CO., Cleveland, Ohio, announces the appointment of Ralph Leavenworth as assistant general sales manager. The company has adopted a system by which either riveting or electric welding may be used in structural steel erection, at the option of the owner.

PACIFIC COAST STEEL CORPORATION, a subsidiary of Bethlehem Steel Corporation, has been formed to take over the properties and business of Pacific Coast Steel Co., Southern California Iron & Steel Co. and the entire Pacific Coast selling organization of the Bethlehem Steel Corporation. In addition to selling the products of the newly acquired plants, the new organization will distribute products manufactured at the Eastern plants of the Bethlehem Steel Co. Headquarters will be in San Francisco, with sales offices in Los Angeles, Portland and Seattle. Principal officers of the new company are: president, D. E. McLaughlin; vice-presidents, T. S. Clingan and Arnold Foster; vice-president and treasurer, E. B. Hill.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., has completed a new 120x300-ft. building in Detroit, Mich. In addition, an open span 90x350 ft., has been developed between the new unit and older buildings for storing material not affected by weather.

STANTON IRONWORKS CO., LTD., near Nottingham, England, has acquired the sole British rights for the Victaulic joint for use with cast-iron pipes.

B. W. & LEO HARRIS CO., Minneapolis, Minn., has contracted with the Caterpillar Tractor Co. for the rights to manufacture and market Russell scrapers, plows and road drags and repair parts.

MCEVERLAST, INC., Los Angeles, Calif., has appointed O. A. Steller manager of its advertising department, Mr. Steller was formerly editor of the magazine *Concrete*.

JOS. F. KIESLER CO., Chicago, Ill., manufacturer of clamshell buckets, announces appointment of F. W. Cherry as sales manager.

MCCLINTIC-MARSHALL CO., Pittsburgh, Pa., has taken over the Riter-Conley Company, which will be operated as the Riter-Conley works of the McClintic-Marshall Co.

ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, Wis., has established a sales office at Chattanooga, Tenn., with D. S. Kerr as representative in charge and A. I. Richardson as sales engineer.

HYATT ROLLER BEARING CO., Newark, N. J., has appointed H. K. Porter general sales manager to succeed H. O. K. Meister, recently promoted to assistant general manager of the company.

BUFFALO STEAM PUMP CO., Buffalo, N. Y., has elected the following officers: president and treasurer, Edgar F. Wendt; vice-president, Henry W. Wendt, Jr.; secretary, Amos G. Peterson; factory manager, Robert G. Nye.

NATIONAL STEEL CORPORATION, Pittsburgh, Pa., has closed down its No. 1 blast furnance at the Weirton Steel Company plant at Wierton, W. Va., for reconstruction. The new furnace, which will be completed and in operation in April, will have a capacity of more than 1,100 tons and will be the largest in the world. Hanna Iron Ore Co., Cleveland, Ohio, a subsidiary of the National Steel Corporation, has leased a number of important ore properties in the Great Lakes region.

INLAND STEEL CO., Chicago, Ill., has purchased the Wheelwright coal mine of the Elk Horn Coal Corporation in the eastern Kentucky coal district and has leased from the Elk Horn Company about 11,000 acres of coal. It is planned to make substantial improvements in the plant and equipment to bring the production up to approximately 1,000,000 tons per year.

WEST COAST WOOD PRESERVING CO., Seattle, Wash., has been organized to operate wood preserving plants of the J. M. Colman Co. and the Pacific Creosoting Co. as a consolidated property. Officers of the new company are: president, Laurence J. Colman; vice-president, L. C. Henry; secretary-treasurer, A. D. Barrall; manager, H. E. Horrocks.

WORTHINGTON PUMP AND MACHINERY CORP., New York City, will be represented in California by a local company, Worthington Machinery Corp. of California, Ltd., with headquarters at Los Angeles and San Francisco. H. D. Cornell will be president of the new company and George W. Hawkins vice-president. Mr. Cornell was formerly president of the Worthington Machinery Corporation of Oklahoma and Mr. Hawkins has been director of sales of the parent company.

STANLEY ELECTRIC TOOL CO., New Britain, Conn., has taken over the manufacture and distribution of a complete line of electrically operated hand tools, including the drills, screw drivers and grinders formerly manufactured by the Stanley Rule & Level plant; saws of the Crowe Safety Saw Company, Inc., Cincinnati, Ohio; hammers of the Ajax Hammer Corporation, New York City; and Unishear, an electrically operated hand tool for cutting sheet metal formerly manufactured by the Unishear Company of New York City. L. M. Knouse is president of the new company.

Costs and Contracts

E. N.-R. Index Numbers

Cost			Volume	
Feb. 1,	1930	206.46	January, 1930	190
Jan. 1,	1930	208.96	December, 1929	166
Feb. 1,	1929	210.40	January, 1929	325
Average,	1929	207.02	Average, 1929	317
Average,	1928	206.78	Average, 1928	287
1913.....		100.00	1913.....	100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Feb. 20, with some comparisons, total as follows:

(In Thousands of Dollars)

	Feb. 20, 1930	Feb. 13, 1930	Feb. 21 1929
Buildings:			
Industrial.....	$3,165	$3,755	$5,354
Commercial....	42,113	15,003	48,074
Streets and roads.	12,629	4,460	2,346
Other eng. constr.	18,244	11,183	10,417
Total.....	$76,151	$34,401	$66,191
Total, all classes, Jan. 1 to Feb. 20:			
1930.....			$377,994
1929.....			668,791